

Operator's Instructions

for

CATERPILLAR

Reg. U. S. Pat. Off.

DIESEL D7 TRACTOR

Effective with
Tractor
7M1 -up

CATERPILLAR TRACTOR CO.
PEORIA · ILLINOIS · U. S. A.

Avoid Accidents

Most accidents, whether they occur in industry, on the farm, at home, on the highway, or at sea, are caused by someone's failure to follow simple and fundamental safety rules or precautions. For this reason most accidents can be prevented by recognizing the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment, there are many conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

A careful operator is the best insurance against an accident.

The complete observance of one simple rule would prevent many thousands of serious injuries each year. That rule is: "Never attempt to clean, oil or adjust a machine while it is in motion."

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PEORIA, ILLINOIS, U. S. A.

Track-Type Tractors . . . Road Machinery
. Diesel Engines

THERE IS A "CATERPILLAR" DEALER NEAR YOU

Foreword

"Caterpillar" products are a combination of advanced engineering, skilled manufacturing, and the finest materials metallurgical science can select. Thousands of satisfying, economical working hours are built into each machine.

Whether or not the owner derives the maximum of service from his machine depends largely on the care exercised in its operation and maintenance. This book is written to give the operator essential information regarding the day-to-day operation, lubrication and adjustment of the machine. Careful adherence to these instructions will result in assured economy.

A great many "Caterpillar" owners depend upon their dealer for service other than the care and adjustments described in this book. This practice is recommended because our dealers are equipped with factory-trained servicemen, tools designed and built by "Caterpillar", and stocks of genuine "Caterpillar" parts. Moreover, they are kept closely informed by the factory regarding advanced methods of servicing "Caterpillar" products — thus, in all ways, they are equipped to render the best of service.

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Lubricating Instructions

Detailed instructions regarding the lubrication of this machine are given on the folded LUBRICATION CHART. Careful attention to these instructions and the proper selection of the lubricants to be used will add much to performance, reliability, economy and long life of your machine.

It is important to use the correct lubricant for each application in the machine — taking into account the current outside temperature and the temperature range which is likely to be encountered before refilling again.

All oil companies have adopted the S.A.E. (Society of Automotive Engineers) viscosity number system—which classifies oils in terms of viscosity or fluidity. The oils with the lower numbers are lighter, and flow more readily than do the oils with higher numbers. The S.A.E. number refers only to the viscosity of the oil, and has reference to no other characteristic or property.

In preparing to refill with fresh oil, any compartment should be drained when it is warm—it is best to drain after the machine has run for some time. Most of the sediment will then be in suspension, and therefore, will drain readily. When draining the crankcase on late machines, remove the oil cooler vent plug from the upper right corner of the core on the engine side so the oil will drain more rapidly. Earlier machines have the vent plug located on the upper right outside corner of the core. After the oil has drained replace the vent plug.

The following recommendations give the types and viscosities of lubricants best suited for use in your machine for various operating temperatures.

Crankcase Lubricating Oils: Two types of lubricating oils should be used for the various services referred to below:

1. Lubricants known as Superior All-Purpose Lubricants for “Caterpillar” Diesel Engines have been developed having such characteristics that they provide the most satisfactory service in “Caterpillar” Diesel engines. Your “Caterpillar” Distributor can give you brand names of these oils that are available in your territory.
S.A.E. No. 20 grade should be used in the engine crankcase at temperatures above freezing. S.A.E. No. 10 oil should be used below freezing to provide better circulation and to make cranking easier. S.A.E. No. 30 oil may be used in **extremely hot** weather.
2. Straight mineral crankcase lubricating oil **only** such as is ordinarily used in automobile and other spark ignition engines of an S.A.E. No. 20 grade should be used in the hydraulic steering clutch control housing at temperatures above freezing. S.A.E. No. 10 should be used at freezing temperature and below. In sub-zero weather the S.A.E. No. 10 oil should be diluted with enough kerosene to insure satisfactory performance.

NOTE: Extreme care should be exercised when filling any compartment with oil to prevent any dirt entering, but such care is especially important when filling the hydraulic steering clutch control housing. All dirt should be carefully removed from the filler plug and the area around it, before removing, to insure against any dirt falling into the housing.

In sub-zero operation, where warm housing facilities are not available, it is advisable to dilute oils, except those used in the air cleaners, with kerosene so that they will be fluid enough to insure free circulation when starting. However, evaporation of the kerosene from the crankcase oil under steady operation makes replenishment essential for proper fluidity. This should be done before stopping; then operate the tractor a few minutes to mix the kerosene and oil.

Naturally, any precautions taken to house the machine or to cover it with a tarpaulin, or to warm it before starting, will cause more rapid oil distribution and contribute to quicker starting. The engine should always be allowed to idle at not less than half throttle for several minutes after starting to assure adequate lubrication before operating on normal load.

When the engine is not operating, the oil will drain back slowly into the crankcase from the oil cooler. Therefore, to obtain an accurate oil level gauge reading, check the oil level while the engine is level and running. A guard protects the gauge from oil splash and assures a correct reading.

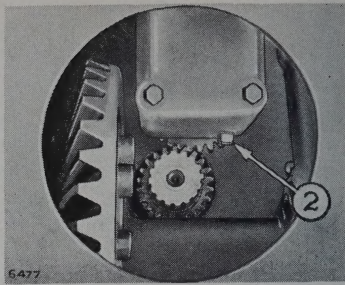
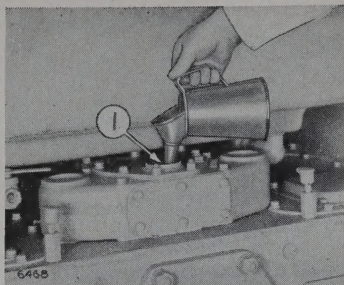
Transmission Oil: Use a pure mineral transmission oil that will flow freely and will not channel at existing operating temperatures. For temperatures above 32° F., (0° C.) use either S.A.E. No. 90 or 140 oil. Below freezing, 32° F., (0° C.) an oil of lower viscosity—S.A.E. No. 80—will be required. In extremely cold weather the oil should be diluted with enough kerosene to provide fluidity.

Track Rollers, Track Carrier Rollers, Track Roller Frame Outer Bearings and Idlers: For temperatures above freezing, use "Chassis Lubricant." For temperatures below freezing, if fluid "Chassis Lubricants" are not available, S.A.E. No. 80 or No. 90 transmission oil may be used. In sub-zero weather, crankcase lubricating oils have proved to be very satisfactory.

Important: Some machines are equipped with heavy duty idlers. Due to their construction and the heavy load imposed upon them, they should be lubricated every 20 hours instead of every 120 hours as recommended for standard idlers.

To distinguish between heavy duty and standard idlers, measure them. The heavy duty idler has an outside diameter of $31\frac{3}{8}$ in. against that of $27\frac{1}{4}$ in. for the standard idler.

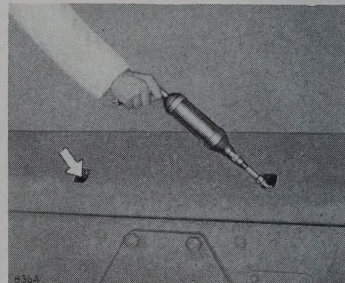
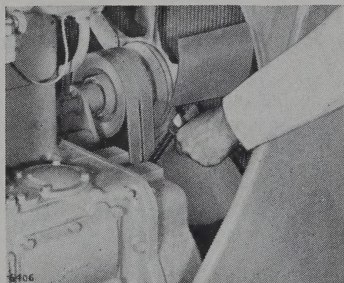
"Chassis Lubricants" are stringy, tacky semi-fluid lubricants. These lubricants should be just fluid enough that they can be handled in the standard volume compressor at the prevailing atmospheric temperature.



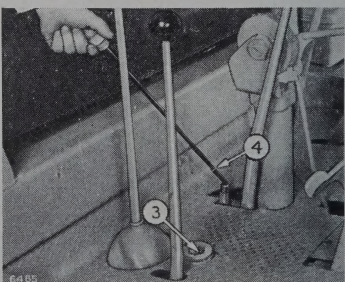
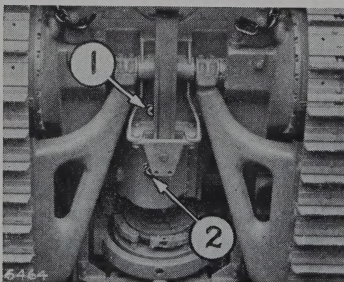
- ① HYDRAULIC STEERING CLUTCH CONTROL HOUSING**—Check oil level (1) every 240 hours and keep filled with straight mineral crankcase lubricating oil to level of bead in strainer. When filling bring oil level up to bead in strainer; then move the steering clutch levers back and forth a few times to force out entrapped air. Add oil to bring up to the level. Exercise great care to exclude all dirt. If it becomes necessary for any reason to drain the housing, remove the drain plug (2) which is reached by removing the cover located in the center at the back of the steering clutch case.

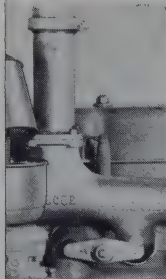
Use the brush supplied in the tool equipment to remove dirt from fittings before lubricating and to clean around air cleaners, breathers and inspection covers before removing. Lubricate all miscellaneous points not equipped with fittings every 60 hours. Use straight mineral crankcase lubricating oil.

DO NOT LUBRICATE TRACKS

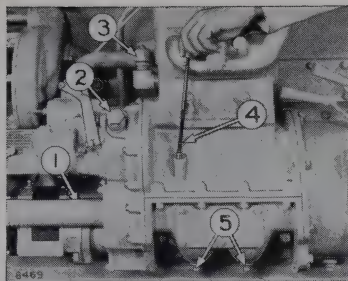


- ⑫ ENGINE FRONT SUPPORT BEARING**—Fill bearing with semi-fluid lubricant every 120 hours.
- ⑬ STEERING CLUTCH RELEASE BEARINGS**—Lubricate with two or three shots of semi-fluid lubricant every 120 hours. SEE NOTE.
- ⑮ TRANSMISSION**—Drain bevel gear compartment (1), and speed change compartment (2), wash and refill (3) with transmission oil to level mark (4) on gauge every 900 hours. Check oil level every 120 hours. Oil in bevel gear compartment adjusts itself to level in speed change compartment. On later machines, before replacing the drain plugs clean all collected particles from the magnet in each.

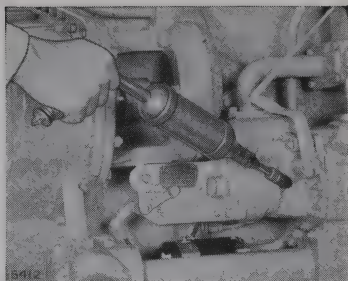




ENGINE AIR CLEANER—Fill in cup and refill with straight mineral lubricating oil every 10 hours depending on dust. Wash filter every 240 hours.

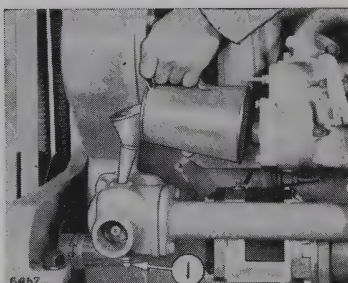


- ⑨ **STARTING ENGINE**—Drain crankcase (5) while hot, wash and refill (2) with straight mineral crankcase lubricating oil to level mark (4) every 120 to 240 hours. Check every 10 hours. Wash breather (3) at each oil change. Oil impulse starter (1) every 600 hours.

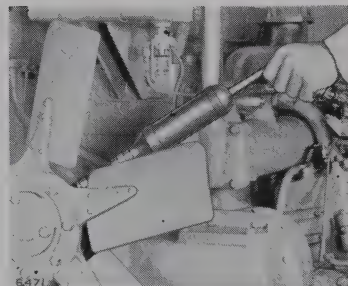


- ⑩ **STARTING ENGINE WATER PUMP DRIVE SHAFT ON MACHINES SO EQUIPPED**—Lubricate bearing with semi-fluid lubricant every 120 hours.

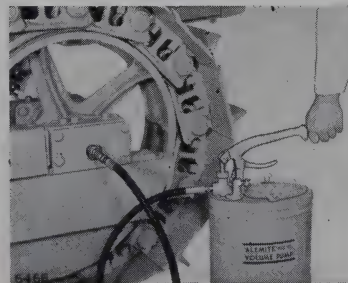
- ⑪ **STARTING ENGINE HAND CRANK GEAR HOUSING**—Keep full by checking oil level every 120 hours. Drain (1), wash and refill with straight mineral crankcase lubricating oil every 900 hours.



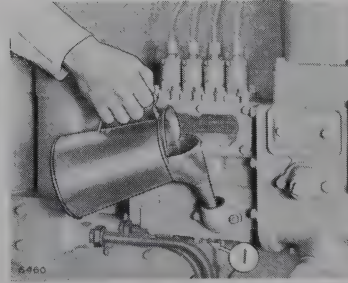
- ⑫ **FAN**—Fill bearing with semi-fluid lubricant every 240 hours.



- ⑬ **FRONT IDLER**—Fill bearings with chassis lubricant every 120 hours. See page nine of Lubricating Instructions for information on heavy duty idlers.

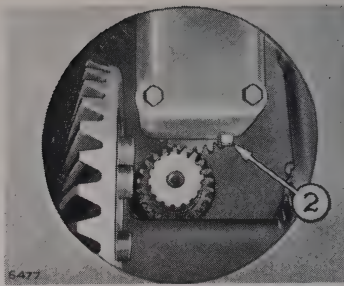
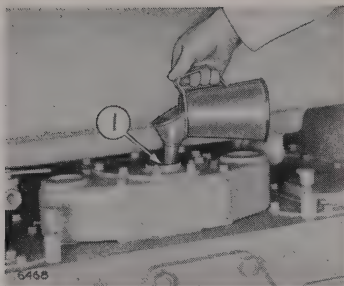


- ⑭ **FUEL INJECTION PUMP HOUSING**—Check oil level every 120 hours and keep full to top of filler elbow with straight mineral crankcase lubricating oil. Drain (1) and refill every 240 hours.



Use Lubricating Oil
Specific, CRANKCASE
Oil if needed to
1/4 pint (0.12 liter)
checked with engine

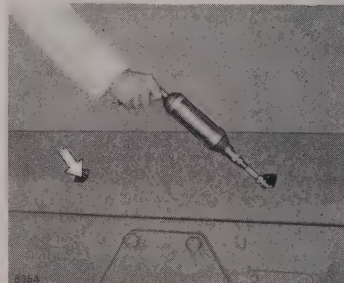
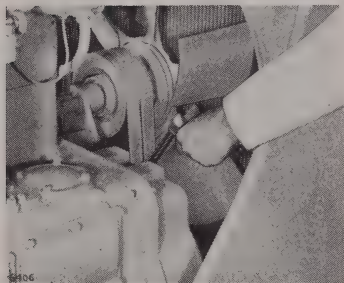




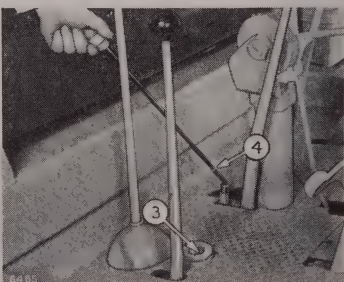
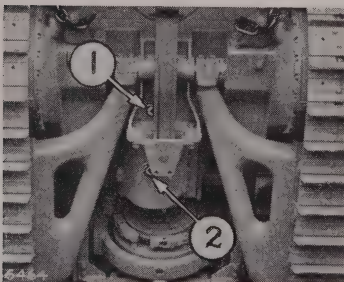
- ① HYDRAULIC STEERING CLUTCH CONTROL HOUSING**—Check oil level (1) every 240 hours and keep filled with straight mineral crankcase lubricating oil to level of bead in strainer. When filling bring oil level up to bead in strainer; then move the steering clutch levers back and forth a few times to force out entrapped air. Add oil to bring up to the level. Exercise great care to exclude all dirt. If it becomes necessary for any reason to drain the housing, remove the drain plug (2) which is reached by removing the cover located in the center at the back of the steering clutch case.

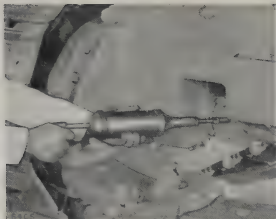
Use the brush supplied in the tool equipment to remove dirt from fittings before lubricating and to clean around air cleaners, breathers and inspection covers before removing. Lubricate all miscellaneous points not equipped with fittings every 60 hours. Use straight mineral crankcase lubricating oil.

DO NOT LUBRICATE TRACKS

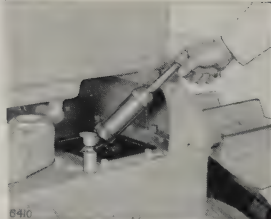


- ⑫ ENGINE FRONT SUPPORT BEARING**—Fill bearing with semi-fluid lubricant every 120 hours.
- ⑬ STEERING CLUTCH RELEASE BEARINGS**—Lubricate with two or three shots of semi-fluid lubricant every 120 hours. SEE NOTE.
- ⑮ TRANSMISSION**—Drain bevel gear compartment (1), and speed change compartment (2), wash and refill (3) with transmission oil to level mark (4) on gauge every 900 hours. Check oil level every 120 hours. Oil in bevel gear compartment adjusts itself to level in speed change compartment. On later machines, before replacing the drain plugs clean all collected particles from the magnet in each.

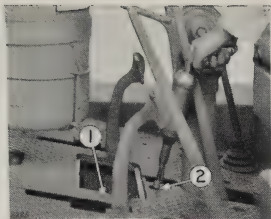




② TRACK ROLLER FRAME INNER BEARINGS—Fill bearings with semi-fluid lubricant every 20 hours.



③ STEERING CLUTCH RELEASE ARMS—Lubricate bearings top and bottom with semi-fluid lubricant every 240 hours. SEE NOTE.



④ FLYWHEEL CLUTCH SLIDING (1) AND SHIFT (2) COLLARS—Lubricate each with two or three shots of semi-fluid lubricant every 10 hours. SEE NOTE.



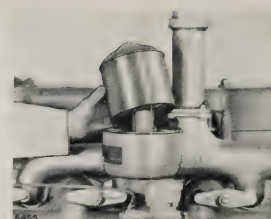
⑤ DIESEL ENGINE AIR CLEANER—Wash and refill oil cup with fresh straight mineral crankcase lubricating oil every 5 to 60 hours and wash filter screens every 60 to 240 hours, depending upon the amount of dust.



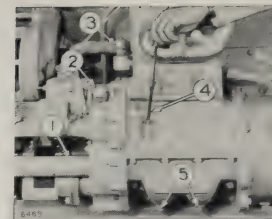
⑥ FLYWHEEL CLUTCH DRIVING PLATE BEARING—Lubricate through fitting with two or three shots of semi-fluid lubricant every 10 hours. SEE NOTE.



⑦ STARTING ENGINE CLUTCH SHIFT COLLAR (1)—Fill oil cup with straight mineral crankcase lubricating oil every 20 hours. CLUTCH AND PINION LEVERS (2)—Fill bearings with semi-fluid lubricant every 120 hours. STARTER PINION SHAFT HOUSING—Drain (3), wash and refill with transmission oil every 900 hours.



⑧ STARTING ENGINE AIR CLEANER—Change oil in cup and refill to correct level with straight mineral crankcase lubricating oil every 60 to 120 hours depending upon amount of dust. Wash filter section every 240 hours.



⑨ STARTING ENGINE—Drain crankcase (5) while hot, wash and refill (2) with straight mineral crankcase lubricating oil to level mark (4) every 120 to 240 hours. Check every 10 hours. Wash breather (3) at each oil change. Oil impulse starter (1) every 600 hours.



⑩ STARTING ENGINE PUMP DRIVE SHAFT—Check oil level every 120 hours. Wash breather (3) at each oil change. Oil impulse starter (1) every 600 hours.

LUBRICATION CHART

CATERPILLAR

REG. U.S. PAT. OFF.

DIESEL D7 TRACTOR

SEE LUBRICATION GUIDE ON REVERSE SIDE

NOTE

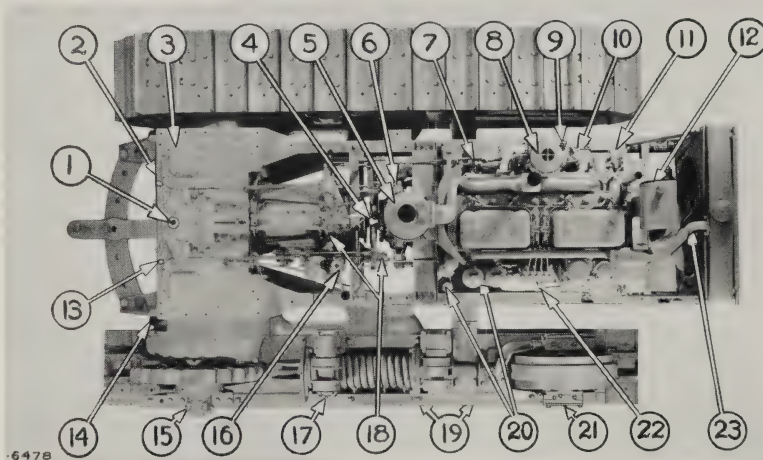
Flywheel Clutch Driving Plate Bearing: On tractors before 7M4325, that are not equipped with enclosed clutch, it is necessary to remove center section of the floor plate to lubricate this bearing.

Flywheel Clutch Shift Collar: Tractors before 7M2108 are equipped with an oil cup. This cup should be filled with transmission oil every 10 hours.

Flywheel Clutch Sliding Collar: Tractors before 7M965 are not equipped with a lubricant fitting at this point.

Steering Clutch Release Bearings: Tractors before 7M5070 are equipped with oil cups which should be filled with lubricating oil every 10 hours.

Steering Clutch Release Arms: Machines beginning with 7M5070 are equipped with a steering clutch releasing mechanism that does not incorporate the release arms, making lubrication at this point unnecessary.



⑭ FINAL DRIVE—Drain (1), wash and refill with transmission oil every 900 hours. Check the oil level every 120 hours.



⑮ TRACK ROLLER FRAME OUTER BEARING—Fill bearings with chassis lubricant every 120 hours.

⑰ TRACK CARRIER ROLLER—Fill bearings with chassis lubricant every 120 hours.

⑱ BRAKE PEDAL SHAFT (1), FLYWHEEL CLUTCH CONTROL LEVER SHAFT (2) AND STEERING CLUTCH CONTROL LEVER SHAFT (3)—Fill bearings with semi-fluid lubricant every 20 hours.

⑲ TRACK ROLLER—Fill bearings with chassis lubricant every 120 hours.

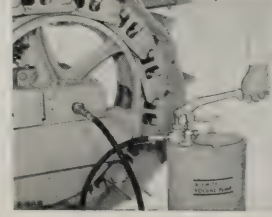
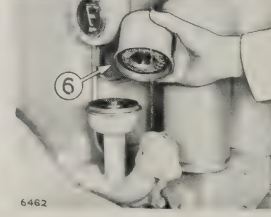
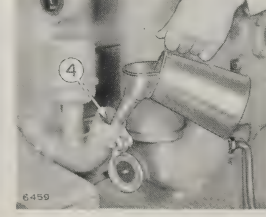
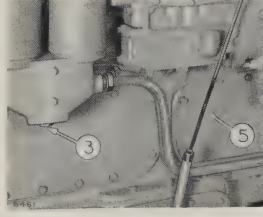
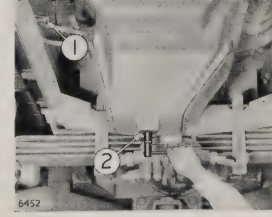
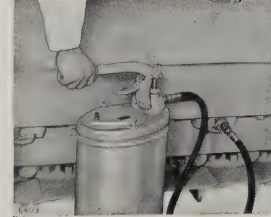
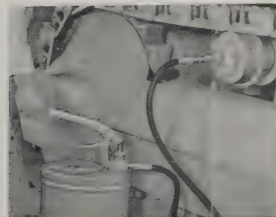
⑳ LUBRICATING OIL SYSTEM—Drain oil cooler (1), crankcase (2) and oil filter (3), while hot, and refill (4) with fresh Superior All-Purpose Lubricating Oil every 240 hours (when extremely dusty, every 120 hours). Replace inner filter elements at every oil change as instructed in the topic, CRANKCASE LUBRICATING OIL FILTER. Start the Diesel engine immediately and run for two minutes to pump oil through filter and oil cooler. Add oil if needed to bring level to full mark (5), on gauge. Wash lubricating oil filter at each oil change. Wash breather element (6) every 240 hours. Four ¼ pint (0.12 liter) straight mineral crankcase lubricating oil through breather element and replace. Check oil level every 10 hours. Oil level may be checked with engine running as guard around the gauge assures an accurate reading.

㉑ STARTING ENGINE HAND CRANK GEAR HOUSING—Keep full by checking oil level every 120 hours. Drain (1), wash and refill with straight mineral crankcase lubricating oil every 900 hours.

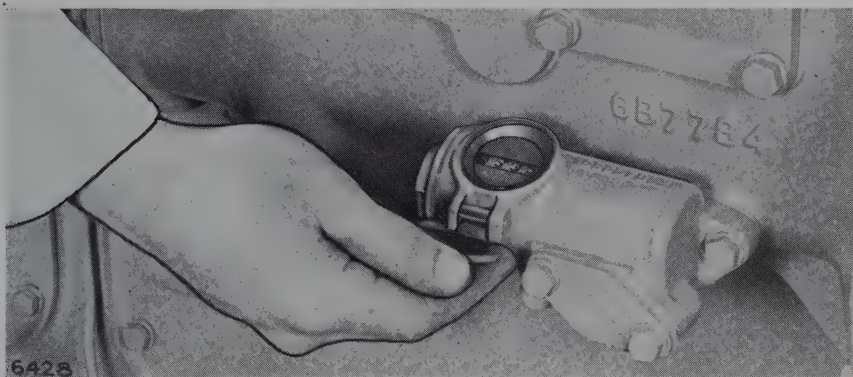
㉒ FAN—Fill bearing with semi-fluid lubricant every 240 hours.

㉓ FRONT IDLER—Fill bearings with chassis lubricant every 120 hours. See page nine of Lubricating Instructions for information on heavy duty idlers.

㉔ FUEL INJECTION PUMP—Check oil level every 120 hours and keep full (1) with straight mineral crankcase lubricating oil (1) and refill every 240 hours.



HOUR METER



COVER ON HOUR METER RAISED TO OBSERVE DIAL READING

This tractor is equipped with an "Hour Meter." It does not keep pace with the clock but it does count the revolutions of the engine.

The dial advances one number each time the crankshaft has turned as many thousands of revolutions as are made in an hour at normal operating speed.

The "Hour Meter" tells more accurately than the clock or calendar when to service your machine.

All time intervals given in the lubricating chart are for hours of Diesel engine operation.

DO NOT LUBRICATE THE TRACKS

Under no circumstances should the track be lubricated. The stiffness noted between the links of a new machine is not caused by a lack of clearance between the track pins and bushings and will disappear as the tracks wear in.



This is a guide to facilitate lubrication of your machine. The numbers listed under “operations” correspond to the numbers and related pictures shown in the lubrication chart on the reverse side. These operations are listed in the order of hourly intervals for each type of lubricant used.

SEMI-FLUID LUBRICANT

Operation	Hourly Interval	Additional Care
4 Flywheel Clutch Shift and Sliding Collars	Two or three shots every 10	
6 Flywheel Clutch Driving Plate Bearing	Two or three shots every 10	
2 Track Roller Frame Inner Bearing	20	
18 Steering Clutch Control Lever Sleeve and Shaft, Brake Pedal Shaft and Flywheel Clutch Control Lever Shaft	20	
7 Starting Engine Clutch and Pinion Levers	120	
10 Starting Engine Water Pump Drive Shaft on Machines so equipped	120	
12 Engine Front Support Bearing	120	
13 Steering Clutch Release Bearing	120	
3 Steering Clutch Release Arm on machines so equipped	240	
23 Fan	240	

TRANSMISSION OIL

Operation	Hourly Interval	Additional Care
14 Final Drive	Check every 120	Wash and refill every 900 hours
16 Transmission	Check every 120	Drain, wash and refill every 900 hours
7 Starter Pinion Shaft Housing	Wash and refill every 900 hours	

SUPERIOR ALL-PURPOSE LUBRICATING OIL

Operation	Hourly Interval	Additional Care
20 Lubricating Oil System	Check every 10	Drain every 120-240 hours. Replace inner filter element at each oil change. Wash breather every 240 hours.

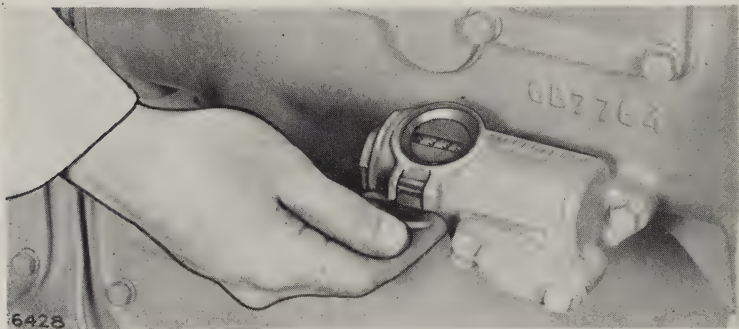
STRAIGHT MINERAL CRANKCASE LUBRICATING OIL

Operation	Hourly Interval	Additional Care
5 Diesel Engine Air Cleaner	Wash and refill every 5-60	Wash screens every 60 - 240 hours
9 Starting Engine	Check every 10	Drain, wash, and refill crankcase every 120-240hours. Wash breather at oil change. Oil impulse starter every 600 hours.
7 Starting Engine Clutch Shift Collar	20	
8 Starting Engine Air Cleaner	Wash and refill every 60-120	Wash filter section every 240 hours
11 Starting Engine Hand Crank Gear Housing	Check every 120	Wash and refill every 900 hours.
22 Fuel Injection Pump Housing	Check every 120	Drain and refill every 240 hours.
1 Hydraulic Steering Clutch Control Housing	Check every 240	

CHASSIS LUBRICANT

Operation	Hourly Interval	Additional Care
15 Track Roller Frame Outer Bearing	} 120	
17 Track Carrier Roller		
19 Track Roller		
21 Front Idler		

HOUR METER



COVER ON HOUR METER RAISED TO OBSERVE DIAL READING

This tractor is equipped with an "Hour Meter." It does not keep pace with the clock but it does count the revolutions of the engine.

The dial advances one number each time the crankshaft has turned as many thousands of revolutions as are made in an hour at normal operating speed.

The "Hour Meter" tells more accurately than the clock or calendar when to service your machine.

All time intervals given in the lubricating chart are for hours of Diesel engine operation.

DO NOT LUBRICATE THE TRACKS

Under no circumstances should the track be lubricated. The stiffness noted between the links of a new machine is not caused by a lack of clearance between the track pins and bushings and will disappear as the tracks wear in.



Operating Instructions

PREPARING THE TRACTOR FOR USE

The first duty of anyone charged with the care and operation of a tractor is to give it a detailed inspection and to lubricate all parts as directed under the topic, LUBRICATING INSTRUCTIONS.

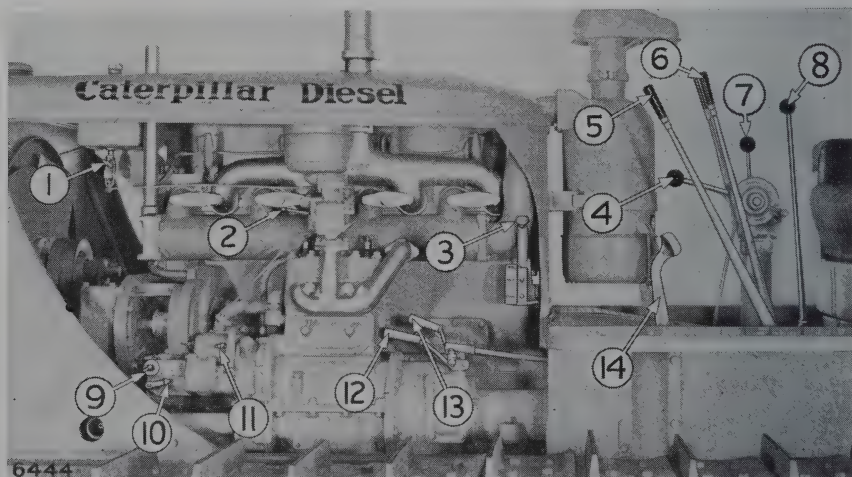
Fill the main fuel tank, taking care that no dirt, water, or other foreign substances are admitted with the fuel. Give particular attention to the details of fuel handling as outlined under the topic, CARE OF THE FUEL SUPPLY. Fill the starting engine fuel tank with gasoline.

Fill the cooling system with clean, soft water, or with the correct anti-freeze solution if temperatures below freezing are likely to be encountered. Water used in the cooling system should be soft, or as free as possible from scale forming minerals. If it is impossible to obtain soft water, it is advisable to treat the available water with some commercial "water softener".

After the first few hours of operation, tighten all nuts, bolts, and cap-screws holding together parts having copper-asbestos gaskets between them. This applies especially to the stud nuts for the Diesel engine cylinder head, the Diesel engine inlet and the exhaust manifolds, the starting engine cylinder head, and the starting engine manifold assembly. When the Diesel engine cylinder head stud nuts are tightened, the cylinder head gasket is squeezed together and the valve clearance is changed. After the cylinder head stud nuts are tightened, adjust the valve clearance as described in the topic, VALVE CLEARANCE ADJUSTMENT.

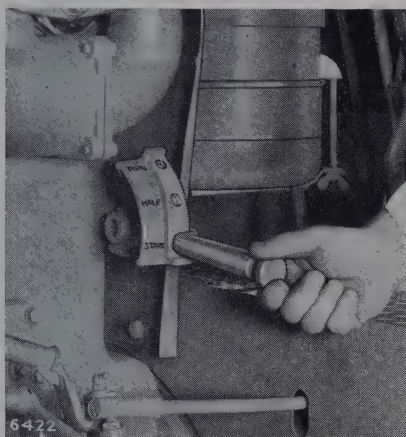
STARTING THE DIESEL ENGINE

If the unit has been in storage and oil added to each cylinder as a precautionary measure to guard against rust due to condensation comply with the starting procedure under the topic, STORAGE.

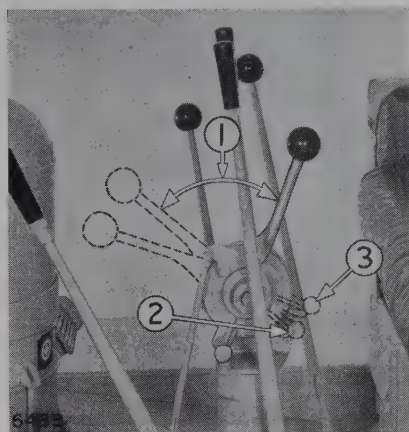


CONTROLS

- 1—Starting engine fuel tank valve. 2—Choke control rod. 3—Compression release lever. 4—Throttle control lever. 5—Flywheel clutch control lever. 6—Steering clutch control lever. 7—Forward and reverse gear shift lever. 8—Speed selector lever. 9—Starting engine magneto switch. 10—Manual spark control lever. 11—Idling latch. 12—Starting engine clutch control lever. 13—Starter pinion control lever. 14—Steering clutch brake pedal.



COMPRESSION RELEASE
LEVER IN START
POSITION



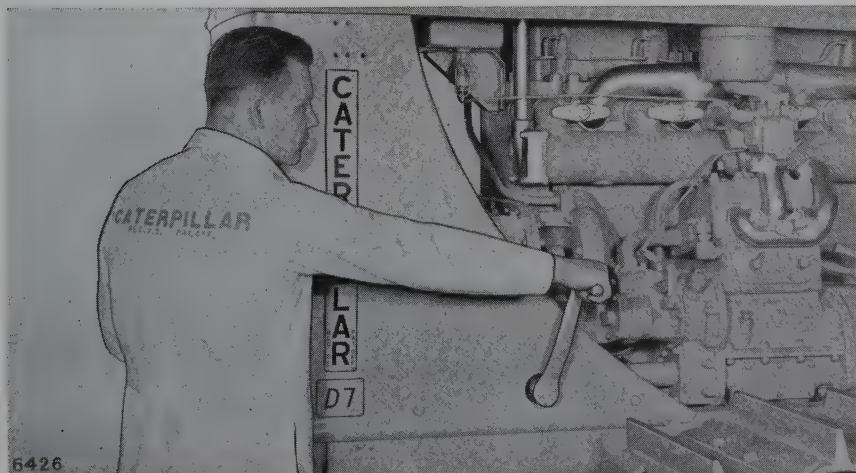
1—THROTTLE CONTROL IN THIS
SECTION. 2—FUEL PUMPS OPEN
WHEN PLUNGER IS AHEAD OF
STOP. 3—FUEL PUMPS CLOSED
WHEN PLUNGER IS BACK OF
STOP.

Starting in cold weather can be facilitated by following the suggestions given under the topic, OPERATING IN COLD WEATHER.

One lever is used to control the opening and closing of the fuel injection pumps as well as the opening and closing of the throttle.

Disengage the flywheel clutch and check to see that the speed selector lever is in neutral. See that the compression release lever is in the START position, and the throttle is locked in the extreme forward position, so that the fuel injection pumps are shut off. Disengage the starting engine clutch lever by pushing it in toward the Diesel engine as far as it will go.

Open the starting engine fuel tank valve and move the idling latch to hold the starting engine governor shaft lever in the idling position. Insert the crank for the starting engine through the opening in the radiator side guard on the left side. If the engine is cold move the manual



CORRECT POSITION FOR CRANKING THE STARTING ENGINE

spark control lever to the ADVANCE position, if the engine is warm move the lever to the RETARD position. Turn the ignition switch ON. Grasp the crank with the right hand.

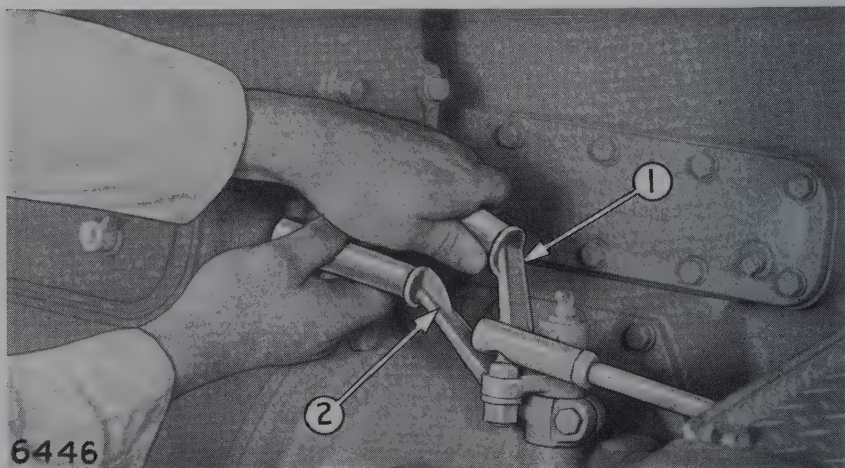
Crank until the engine starts by pulling the crank forward from the top of the cranking stroke. **Do not attempt in any manner to spin the crank.** Remove the crank after the engine starts. Temperature and altitude will vary the length of time it is necessary to have the choke "on" and actual experience in starting will determine this interval. The manual spark control lever should be engaged in the ADVANCE position as soon as the engine has started.

The choke operates in a positive manner for three-fourths the choke rod travel, at which position the valve is fully closed. Pulling the choke rod the last fourth of its travel, trips the positive control and the valve is then held in the closed position by spring tension. The spring tension allows the choke valve to automatically open when the engine starts which prevents flooding before the choke control rod is returned to the OFF position. Pushing the choke rod all the way in returns the choke to the OFF position and re-engages the positive control. For this reason if it is necessary to choke the engine when starting, **the choke control rod should always be pulled out all the way.**

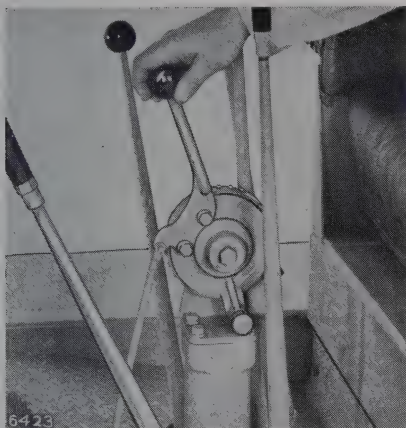
When the engine starts, allow it to run long enough at idling speed to distribute the crankcase lubricating oil thoroughly before running it at its governed speed.

The starting engine cranks the Diesel engine through a sliding pinion which is engaged with the flywheel gear by pulling out on the starter pinion control lever. If the pinion does not engage readily, partially engage the starting engine clutch for an instant so the teeth will mesh with the flywheel gear. The clutch is provided with a brake to stop the clutch shaft from turning. To apply the brake, push the clutch lever toward the Diesel engine as far as it will go.

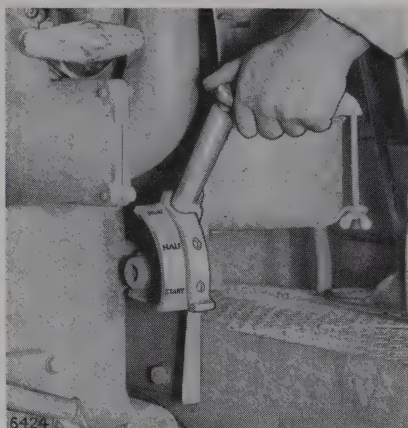
After the pinion is engaged, allow the starting engine to run at full governed speed by releasing the idling latch. Then engage the starting engine clutch by pulling the lever out as far as it will go.



1—ENGAGING STARTER PINION. 2—ENGAGING STARTING ENGINE CLUTCH.



COMPRESSION RELEASE LEVER
IN RUN POSITION



POSITION OF THROTTLE CONTROL
LEVER FOR STARTING

During cold weather, if the starting engine slows down to the stalling point when the clutch is engaged, disengage the clutch and allow the starting engine to pick up speed again.

When the starting engine is cranking the Diesel engine against compression (with the compression release lever in the RUN position), the heat of compression warms the cylinders, pistons, and combustion chambers to the temperature necessary for starting. For this reason, best results are obtained by moving the compression release lever to the RUN position as soon as the starting engine will turn the Diesel engine at normal cranking speed.

The temperature indicator registers the temperature of the water at the cylinder block outlet manifold. Altitude and temperature cause a variation in the length of time required to warm the engine before starting. In cold weather the cylinders and pre-combustion chambers must absorb more heat before reaching starting temperature than in warm weather. Even in warm weather some heat must be added by turning the engine against compression a few minutes before injecting fuel. For these reasons no definite indicator reading can be established as satisfactory for starting under all conditions. By actual experience determine the proper reading of the temperature gauge at which the Diesel engine will start readily without disengaging the starter pinion and stalling.

After the starting engine has cranked the Diesel engine against compression for a few minutes and the temperature indicator shows the proper reading, then pull out the plunger stop and pull the throttle control lever back about half way. If the engine does not fire after it has turned several revolutions, move the throttle to the extreme forward position with the plunger locked and let the starting engine turn the Diesel engine a little longer to raise its temperature.

If the Diesel is thoroughly heated but does not start, make an inspection to see that everything is correctly set for starting. If smoke has been coming from the Diesel exhaust pipe, fuel has been reaching the cylinders. If no smoke has been evident when the throttle control lever was in the RUN position, check the fuel supply. If the main fuel tank is empty or the fuel tank valve is closed, it will be necessary to prime the system as outlined under the topic, PRIMING THE FUEL SYSTEM. In case there may be water or dirt in the fuel system, or if the fuel injection

equipment is suspected, see the topic, **TESTING THE FUEL INJECTION EQUIPMENT**.

When the Diesel begins to fire the starter pinion disengages automatically but it is necessary to disengage the starting engine clutch by pushing the clutch control lever in toward the engine. Stop the starting engine by closing the valve under the starting engine fuel tank, allowing the engine to burn all the fuel in the carburetor. Then turn the ignition switch OFF.

Check the lubricating oil pressure gauge to see that it is registering in the "Operating Range."

Allow the Diesel engine to idle 5 minutes with the throttle at least half open, and 5 minutes at full speed before applying the load.

DRIVING THE TRACTOR

Operate a new tractor under light load for the first sixty hours.

When the engine has been running long enough to warm up, move the throttle control lever to the idling position. Disengage the flywheel clutch by pressing the clutch control lever forward as far as it will go. This applies the clutch brake. Continue to press forward on the lever until the clutch stops turning. Carefully move the speed selector lever into position for the speed desired. The speed selector lever is the inside lever and the forward and reverse lever is the outside lever.

The clutch lever controls the locking mechanism that holds the sliding transmission gears in position. Thus the gears cannot be shifted out of mesh or in mesh when the clutch is engaged. Always shift gears completely into mesh.

After putting the gears in mesh and shifting the forward and reverse lever into the position desired, pull the throttle control lever all the way back. Carefully engage the flywheel clutch until the slack is taken up between the tractor and the load, then pull the clutch lever back firmly until it snaps over center.

There are five forward and four reverse speeds in the transmission. Each of the four lower forward speeds has a comparable, slightly higher, reverse speed. Shifting from forward to reverse or reverse to forward in any of these four gears is accomplished without shifting the speed selector lever, by disengaging the flywheel clutch and shifting the forward and reverse gear shift lever forward to operate in reverse, and backward for forward travel.

STEERING THE TRACTOR

The tractor is steered by hand levers that operate the steering clutches, and by pedals that control the steering clutch brakes. The hydraulic control arrangement operates in conjunction with the steering clutch controls and minimizes the effort required to release the clutches during operation of the tractor. Release the steering clutch on the side toward which the turn is to be made by pulling back on that steering clutch lever. Apply the brake on the same side by pressing down on the pedal just hard enough to turn at the desired angle. Both controls should be handled smoothly so that the turn will be made evenly and not as a series of jerks. Just before the turn is completed, release the brake. Then engage the steering clutch by releasing the control lever quickly but gently.

With a load behind the tractor it is seldom necessary to use the brakes in steering, except for sharp turns, since the load acts as a brake. The brakes may also be used to hold the tractor back when going down

grade, and one pedal may be locked in position to hold the tractor on slopes or when doing stationary work.

Steering down grade: When going down grade with the tractor **pulling** the load, steer in the usual manner. If the load is **pushing** the tractor, the operation of the steering clutches and brakes is reversed. For example, to turn to the right under these conditions, release the steering clutch on the left, but do not apply the brake. This allows the left track to travel faster while the right hand track is held back by the engine which acts as a brake.

The brakes must be in the fully released position during normal operation of the tractor. **Keep the feet off the pedals except when it is necessary to apply the brakes.**

OPERATING OVER AN OBSTRUCTION

The fact that the steering clutches are controlled by separate levers may be used to advantage in running over an obstruction, such as a log or a ditch bank. Both of the clutches may be released slightly until the tractor balances on top of the obstruction. Then one clutch may be engaged gradually so that the tractor moves forward at an angle, over and down. If the tractor is being operated without a load it may be necessary to use the brakes.

OPERATING IN DEEP MUD OR WATER

If the tractor must be operated for any length of time in deep mud or water, certain precautions are necessary. See that the plugs are in place under the steering clutch compartments. Lubricate the track rollers and the front idlers every 5 hours. Inspect the oil in the final drives frequently for mud or water and drain, wash, and refill as often as the oil shows the presence of any mud or water. See the topic, LUBRICATING INSTRUCTIONS.

STOPPING THE TRACTOR

To stop the tractor when it is desired to allow the engine to continue to run, disengage the flywheel clutch, and move the throttle control lever to the idling position. Shift the forward and reverse lever into neutral and engage the flywheel clutch. **Do not allow the tractor to idle with the flywheel clutch disengaged.**

If it is desired to use the tractor for stationary work, such as belt work, this is accomplished in the same manner as described above except that the speed selector lever should be moved to the neutral position. Then engage the forward and reverse lever in either the forward or reverse position.

STOPPING THE DIESEL ENGINE

After the normal load is removed from the engine allow it to idle five minutes with the throttle half open before stopping.

Move the throttle control lever to the STOP position. While the engine is slowing down, shift the compression release lever to the START position. **Leave the main fuel tank valve open.**

If the tractor must stand without shelter, cover the exhaust pipes to exclude rain or snow. If the temperature is below freezing, or if freezing weather is expected before the engine will be started again, drain the cooling system or protect it with an anti-freeze solution. See the topic, OPERATING IN COLD WEATHER.

DAILY CARE

A daily check of the tractor should be made to see if there are any loose nuts, bolts, capscrews, or parts worn to such an extent that they are no longer serviceable. The capscrews of the track roller end collars, and the equalizer spring clip nuts are typical of points which should be checked frequently and kept tight, since these parts are subjected to continued pounding. Particular attention should also be given to keeping the gasketed joints of the final drive cases drawn up tight to prevent leakage and possible damage to parts through excessive movement. If corrective steps are taken immediately upon discovery of loose or worn parts, fewer enforced stops and more economical operation will result.

Dirt should not be allowed to accumulate on the tractor. A few minutes spent daily in keeping it clean are well repaid in improved appearance, and greater ease and safety in operation.

Check the cooling system each day, and if necessary, add water or anti-freeze solution.

Lubricate all parts as directed under the topic, LUBRICATING INSTRUCTIONS.

Fill the fuel tank **full** at the end of the day's run. This will not only drive out moisture-laden air and prevent condensation, but will give any sediment which may be in the fuel a chance to settle out. Open the drain valve on the main fuel tank every 120 hours before the tractor is started and allow the accumulated water and sediment to drain.

When the Diesel engine is operating continuously, the starting engine should be run for a few minutes each day to dissipate condensation and renew the oil film on the bearing surfaces.

OPERATING IN COLD WEATHER

If the starting engine and the Diesel engine are both in good mechanical condition and precautions necessary for cold weather operation are taken, ordinary cold weather will not cause difficulty in starting or loss of efficiency.

Crankcase: As the atmospheric temperatures become lower, and warm housing facilities are not available, a crankcase lubricating oil having a lower viscosity and pour point must be used to properly lubricate the bearings, pistons, and cylinder walls when starting. See the topic, LUBRICATING INSTRUCTIONS.

Transmission, Final Drives, Track Rollers, Track Carrier Rollers and Idlers: Like the crankcase lubricating oil, the viscosity of the lubricant used in the transmission, final drives, track rollers, track carrier rollers and idlers should be changed for cold weather operation. See the topic, LUBRICATING INSTRUCTIONS.

Cooling System: When the temperature is below freezing, sufficient anti-freeze solution should be used in the cooling system to prevent freezing. Commercial solutions are available for this purpose, or glycerine may be used. Alcohol can be used successfully but, because it readily evaporates at the normal operating temperature of the engine, which is approximately 170°F. (77°C.), these solutions should be tested frequently—even daily—and kept up to correct strength.

Fuel: Fuel must be "free flowing" enough to flow readily through the fuel lines at the lowest temperature at which the tractor will be started and operated. For additional information, refer to the topic, FUELS.

Starting the Diesel Engine: If the tractor has been standing without shelter in extremely cold weather, the following suggestions will materially assist starting:

It is very important to keep low viscosity crankcase lubricating oil in both the Diesel engine and starting engine. Refer to the topic, LUBRICATING INSTRUCTIONS.

Sometimes moisture, or fuel which has not vaporized, collects on the starting engine spark plugs. They may be dried out by removing and pouring gasoline over the electrodes. Ignite the gasoline and allow it to burn.

Pouring a small amount of gasoline on the electrodes before they are replaced in the engine is more effective in promoting combustion than priming the cylinders with raw gasoline. A small amount of raw gasoline in the cylinders will remove the film of oil from the cylinder wall and interfere with compression.

The starting engine of earlier tractors is equipped with a water pump. On these tractors, if the starting engine seems to be locked on the first attempt to turn it, warm the starting engine water pump body to be sure the pump impeller or shaft is not frozen.

Avoid over-choking and over-priming the starting engine when attempting to start it.

Sometimes the starting engine can be started more quickly by leaving the idling latch free of the governor shaft lever. As soon as the engine starts, move the governor shaft lever to the idling position to keep the engine speed low enough to prevent burning out bearings or scoring cylinders before the crankcase lubricating oil has a chance to warm up and lubricate these parts.

With the starter pinion engaged, partially engage the starting engine clutch to be sure the Diesel engine will turn. If the engine seems locked on the first attempt to turn it, see if the water pump impeller is frozen tight. If so, warm the pump body to melt the ice.

STORAGE

Engine: If the tractor is to be stored or left standing for a long period of time there is a probability that the lubricating oil will drain away from the cylinder walls and piston rings, causing them to rust. There is also the possibility that the pistons and cylinder walls may be scored when the engine is started before fresh oil has reached these surfaces. This condition may cause poor compression and make starting difficult. The oil film must be renewed periodically when the tractor is idle.

On the Diesel engine this should be done by running the engine once a week until it is thoroughly warm. This will circulate the oil and prevent rusting from condensation. If it is not convenient to start the engine, remove the injection valves once a month and pour about $\frac{3}{8}$ pint (0.18 liter) of straight mineral crankcase lubricating oil into each cylinder. Then turn the engine several revolutions with the compression release

lever in the START position and the throttle lever in the STOP position. Replace the injection valves. Thereafter, turn the engine once a week between monthly oiling intervals to distribute the oil on the cylinder walls and pistons.

Before Starting: If rusting in the Diesel engine has been guarded against by pouring oil into the cylinders rather than by running the engine, the following precaution should be observed.

Move the compression release lever to the START position to release the compression, then turn the engine to dissipate oil that may have accumulated in the cylinders.

If excess oil is not removed, compressing it in the small space between the piston and cylinder head will cause damage to the engine and related parts.

The oil film should be renewed in the starting engine by running the engine once a week until it is thoroughly warm. If it is not convenient to start the engine, remove the spark plugs once a month and pour about $\frac{1}{8}$ pint (0.06 liter) of oil into each cylinder. Then crank the engine several revolutions and replace the spark plugs. Thereafter, turn the engine once a week between monthly oiling intervals to distribute the oil on the cylinder walls and pistons.

Final Drive: Allowing the tractor to stand idle for lengthy periods may permit the cork gasket on the final drive seals to become lightly stuck to the chromium plated washer on which it operates. When this occurs the gaskets may be damaged when the tractor is operated, causing the seals to leak. For this reason, the tractor should be driven backward and forward, at a time when starting the engine to renew the oil film on the cylinder walls and piston rings, to prevent this condition occurring.

Cooling System: If the temperature will be below freezing, the cooling system should be drained or the correct amount of anti-freeze solution added. See the topic, OPERATING IN COLD WEATHER.



Maintenance Instructions

The foregoing paragraphs have been devoted to instructions which are necessary for day-to-day operation of the tractor. The following topics give detailed instructions regarding the care and adjustment of the various assemblies.

CARE OF THE AIR CLEANERS

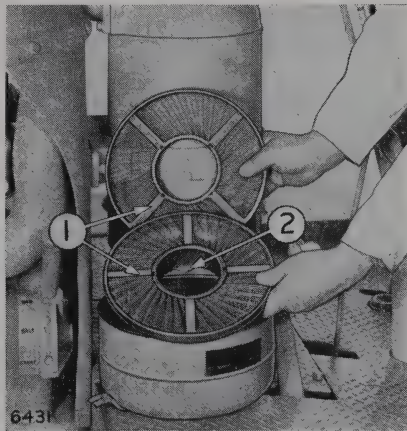
The air cleaner on a Diesel engine will clean and pass a greater volume of air in a day's run than the air cleaner on a gasoline engine doing the same work under like conditions. Each Diesel engine cylinder draws in a full charge of air on every inlet stroke, regardless of the engine speed or the amount of work the engine is doing, whereas the volume of air taken in by a spark ignition engine is regulated by the position of the butterfly valve in the carburetor and changes with varying conditions.

The air cleaners do their work efficiently only as long as the oil in the cup is thin enough to flow freely, so it will spray into the filter section and wash back the dirt collecting there. For this reason, air cleaners should be inspected frequently and serviced promptly.

The interval between oil changes and cleaning will vary with the weather and the working conditions. During the hot dusty months, and on jobs where dust conditions are severe, it may be necessary to service the Diesel engine air cleaner every 5 hours. In cold, damp weather, and on jobs where there is little or no dust, this operation may be necessary only every 60 hours. However, dependence should not be placed in visible detection of dust, or lack of dust, in the air as a basis for servicing the air cleaner. The high efficiency of the pre-cleaner prevents the larger dust particles from entering the air cleaner, but it does not exclude the finer ones. For this reason the oil in the air cleaner may become saturated with dust, due to its fineness, much more rapidly than in instances where dust is more apparent.



PRE-CLEANER
1—Screw clamp. 2—Jar.



REPLACING AIR CLEANER
SCREENS
1—Frame cross arms facing each other.
2—Holes in lower screen for clamp bolts.

The fine particles of dust become suspended in the oil, lowering its cleaning efficiency, without leaving any noticeable sediment in the cup. Consequently, the best guide to follow in servicing the air cleaner is the appearance of the oil which will become increasingly cloudy. The air cleaner cup should be removed, washed and refilled at a time between 5 to 60 hours when the oil shows evidence of being murky or cloudy.

Care Of The Pre-Cleaner: Remove and empty the glass jar before it becomes three-fourths full by loosening the screw clamp that holds it in place (on earlier machines the jar is screwed in position on the pre-cleaner). Inspect the fins in the pre-cleaner regularly and when dirty remove entire pre-cleaner and wash in a non-inflammable cleaning fluid.

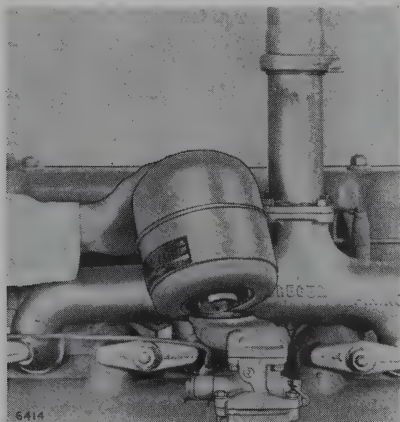
To Wash Air Cleaner Screens: Unscrew the wing nuts and take off the oil cup. Inspect the screens in the air cleaner at periods between 60 to 240 hours, depending upon severity of dust conditions and wash if necessary. Remove the lower screen by unscrewing the two wing nuts that hold it in place and slip the other screens off the air inlet pipe, one at a time, and shake in a pan of kerosene or some non-inflammable cleaning fluid. When a screen is found that is perfectly clean, there is no need to remove the screens above it. Only six screens are removable. Inspect the inside of the air inlet pipe each time the oil cup is removed and clean if necessary.

Replace the screens so the frame cross arms of each pair are facing each other. The wing nuts holding the screens in place should be drawn up snugly to prevent vibration of the screens. Refill the oil cup to the oil level mark and replace it. Make sure all connections are air tight.

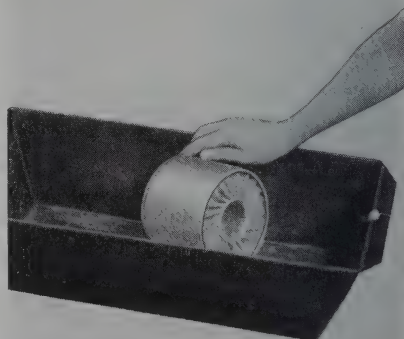
When refilling the oil cup, care should be taken that both the inner and outer sections of the cup are filled to the oil level bead. Fill to the level bead only, as a higher oil level does not increase efficiency; in fact it prevents proper oil spray action in the air cleaner.

Never attempt to change the oil in the air cleaner cup when the engine is running. Doing so will permit dirty oil being held in the screens by intake action to contaminate the fresh oil and also cause an abnormally high oil level.

At least once a year—more often in dusty conditions—the entire air cleaner should be removed from its support in order to thoroughly flush out the fixed screens in the upper part of the filter body. To facilitate



REMOVING STARTING ENGINE
AIR CLEANER



WASHING STARTING ENGINE
AIR CLEANER

cleaning, first remove the oil cup and removable screens. Wash all parts thoroughly and when reassembling, make certain that all connections are air tight.

To Wash Starting Engine Air Cleaner: Unscrew the fastening stud at the top of the dome and remove the filter section from the oil cup. Wash by shaking the filter section in a pan of kerosene or some non-inflammable washing fluid. Wash and refill the oil cup and re-assemble the air cleaner. Keep the connection air tight.

FUELS

The "Caterpillar" Diesel engine offers outstanding advantages in the economy of operation for two reasons—it burns the heavier, less expensive distilled fuels and performs a unit of work on less fuel than is required in a spark ignition engine. While the Diesel engine will operate on almost any petroleum fuel for some time, it is important that good grades of CLEAN distillates be supplied, if the engine is to give long, economical service.

In the United States of America and Canada, usually commercial No. 3 domestic burner fuel provides satisfactory as well as most economical operation. "Diesel Fuels" at premium prices are seldom required for "Caterpillar" engines. However, in some Export Territories, the wide variation in quality of fuels will not permit making simple recommendations as in the United States of America and Canada. For this reason, we suggest that a "Caterpillar" Export Dealer be consulted for recommendation of the brand names of satisfactory Diesel fuels.

The most important qualification of Diesel fuel is cleanliness. To keep the fuel injection equipment in its most efficient condition, it is necessary to keep all dirt, dust, water and sediment out of the fuel. Important, useful suggestions for storage and handling of Diesel fuel are included in this book—refer to the topic, CARE OF THE FUEL SUPPLY—and also in the booklet CLEAN FUEL, included with the tool equipment of all "Caterpillar" Diesel-powered machines.

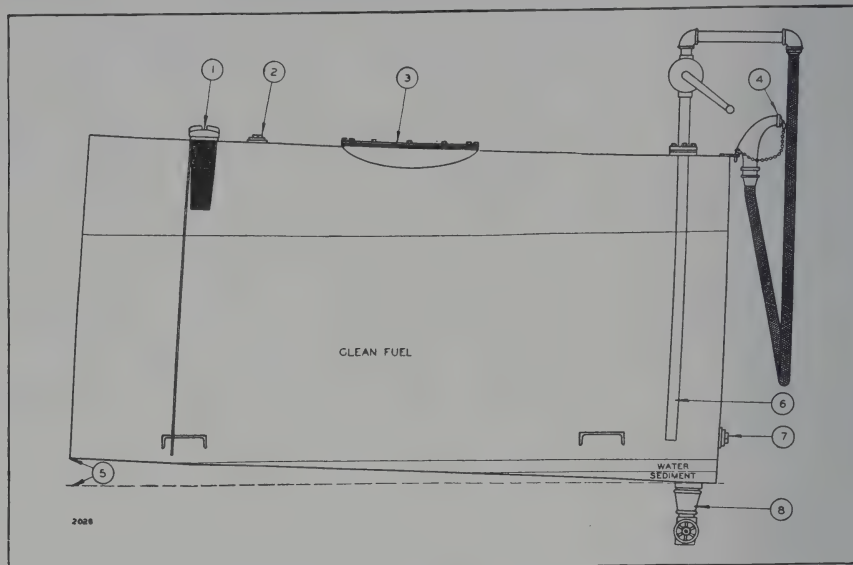
In subzero ($-18^{\circ}\text{C}.$) weather, where warm storage is not provided for the machine, distillates with unusually low pour points may be required. It is necessary that the fuel be fluid enough to flow from the main tank to the engine transfer pump at the lowest temperature at which the engine must start and operate. Your "Caterpillar" Dealer is familiar with this requirement and should be consulted regarding the proper fuel to use when colder temperatures are encountered.

CARE OF THE FUEL SUPPLY

Keep the Fuel Clean: Too much emphasis cannot be placed on the importance of using only clean Diesel fuel. In selecting a fuel, it should be pointed out that distillates are especially desirable because, in refining, they are heated to a vaporous state and condensed in another container; thus, all the sediment and residue remain in the still.

It is not only important to **buy** clean fuel, but it must be **kept** clean. The best fuel can be rendered unsatisfactory by inadequate storage facilities or careless handling. The clearance between the fuel injection pump plunger and the barrel is very small, actually less than .0001 inch (0.00254 mm.), which makes it evident that the invisible particles of dirt that pass through the filters can damage these finely-finished parts.

Effort should be constantly exerted to prevent contamination of the fuel. An important step is to reduce the number of times the fuel must be handled. When the fuel can be delivered by the distributor to storage tanks and then pumped from the storage tank to the engine tank, the handling is reduced to a minimum.



RECOMMENDED FUEL STORAGE TANK

1—Filler cap. 2—Vent. 3—Manhole for cleaning tank. 4—Protect hose nozzle from dust with a screw cap. 5—Rear of tank should be 4 inches (10 cm.) higher than front to assist settling. 6—Intake pipe on pump should be 4 inches (10 cm.) above tank bottom. 7—Tap on elevated tank should be 3 inches (7.6 cm.) above tank bottom. 8—Drain cock for drawing off water and sediment.

The illustration here given of a fuel storage tank is a typical, satisfactory installation. Since natural settling is an effective method of cleaning Diesel fuel, the fuel should be allowed to stand at least 24 hours in the storage tank after it has been filled before fuel is transferred to the engine tank. Be sure to drain all water and sediment that has settled to the bottom of the tank before the tank is refilled. Occasionally, drain all of the fuel and clean the tank thoroughly.

The use of cans, funnels and drums should be discouraged since it is practically impossible to keep this equipment absolutely clean. If drums must be used, they should be allowed to stand for at least 24 hours before drawing off fuel. A pump installation similar to that shown with the storage tank should be used. The drum should stand on end and the inlet for the pump be kept several inches above the bottom to prevent stirring up the sediment that settles to the bottom.

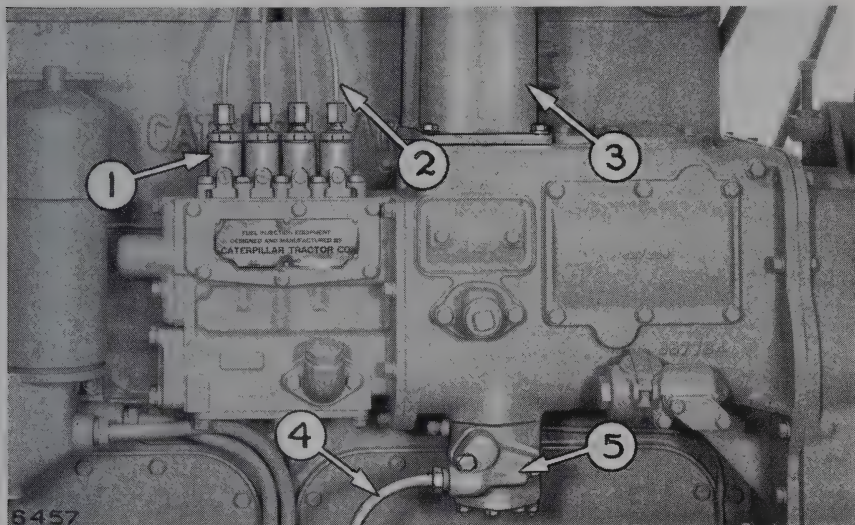
Whatever method is used, see that only clean fuel enters the engine tank.

Fill the engine tank at the end of the day, which will drive out the moisture-laden air and prevent condensation. Every 120 hours before starting the engine, open the drain cock under the fuel tank and drain any sediment or water which may have accumulated. The screen in the fuel tank filler opening should be removed and cleaned regularly.

The fuel tank filler cap elements should be washed every 60 to 240 hours depending upon the amount of dust in the air. To do this, remove the nut from the stud and take out the baffle plate and gasket. Wash the cap and elements in a pan of kerosene or some non-inflammable washing fluid. After the cap is washed, pour a small amount of crankcase lubricating oil on the filter elements.

Clean the fuel filter as outlined under the topic, CARE OF THE FUEL FILTER.

FUEL INJECTION SYSTEM



FUEL SYSTEM

- 1—Fuel injection pumps. 2—Fuel injection lines. 3—Fuel filter.
4—Main fuel line. 5—Fuel transfer pump.

The fuel flows from the fuel tank through the fuel line to the fuel transfer pump. The fuel transfer pump supplies the fuel under pressure to the fuel filter, which removes dirt and other foreign particles. From here the fuel is supplied to the fuel pump manifold for the individual fuel injection pumps. The fuel injection pumps meter and force the fuel through the fuel injection lines to the fuel injection valves in the cylinder head, into the pre-combustion chamber where it is ignited and passed into the main combustion chamber or cylinder.

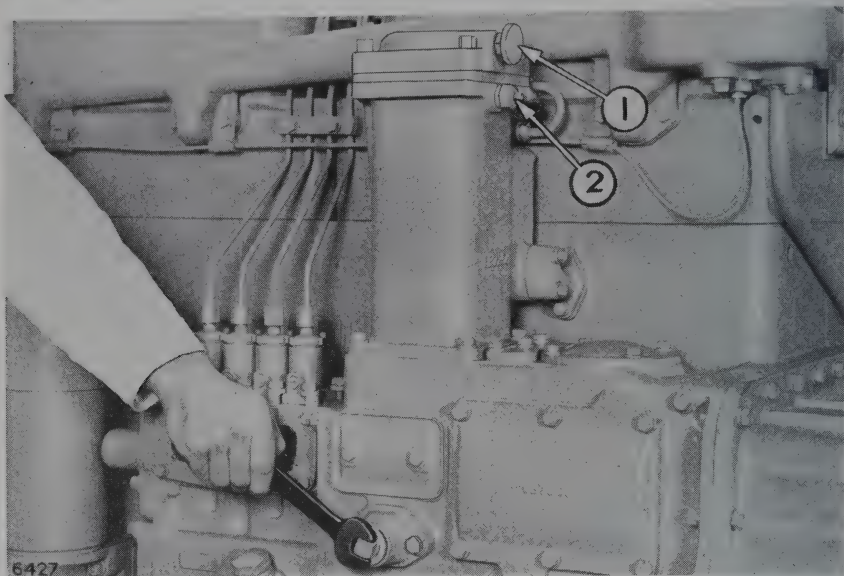
CARE OF THE FUEL FILTER

Every sixty hours, drain the filter housing of sediment and water which settles to the bottom of the compartment. To do this close the main fuel tank valve, remove the filter housing drain plug and open the lower and then the upper vents in the housing. Replace the drain plug, and prime the system. See the topic, PRIMING THE FUEL SYSTEM.

When the absorbent filter elements have collected enough contamination to interfere with engine performance, they must be replaced. These elements will continue to absorb particles until fuel will no longer flow through them. They will not discharge their burden into the clean fuel; the fine grade filter paper at the core prevents this from happening.

Because these filter elements absorb and hold contaminants, they cannot be washed or otherwise restored.

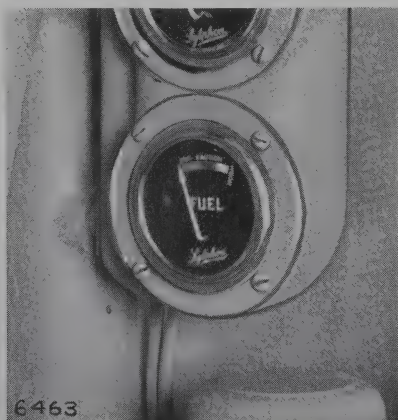
As the filters gradually become clogged with foreign material, the position of the fuel gauge indicator will work back from the original position in the NORMAL (white) range, to the CAUTION (green) range, and later into the OUT (red) range. When a considerable stoppage has occurred, the indicator will show a marked reduction in pressure from no load to full load.



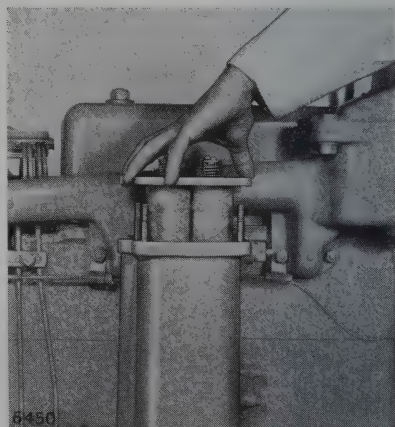
DRAINING FILTER HOUSING
1—Upper vent. 2—Lower vent.

The exact point on the OUT range which the indicator will register before the resistance to fuel flow interferes with the maximum performance of the engine can best be determined by experience with the individual machine, taking into consideration the machine load, operating speed, temperature of the engine, and viscosity of the fuel. When the old filter elements become clogged, they should be discarded and all new filter elements installed — never only one.

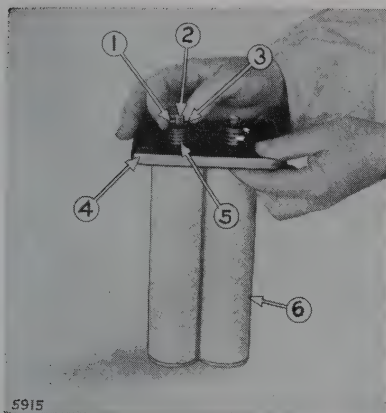
Removing the used filter elements: Remove the engine hood. Thoroughly clean the top of the filter cover and around the edges of the gasket joint between the filter body and cover, to guard against loose dirt dropping into the filter housing when the cover is removed. Drain the filter housing.



FUEL PRESSURE GAUGE

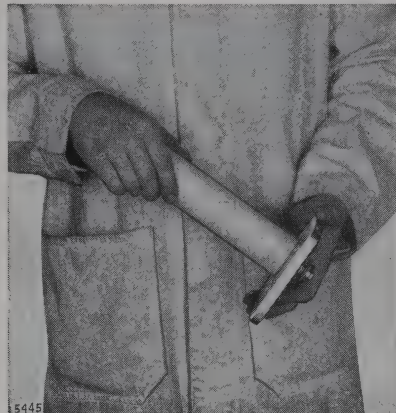


REMOVING FUEL FILTER ASSEMBLY



REMOVING FILTER ELEMENT

- 1—Pin. 2—Retainer rod. 3—Retainer.
4—Filter element plate. 5—Spring.
6—Filter element.



SEATING FILTER ELEMENT

Remove the cover, and lift the assembly of filter element plate and filter elements out of the housing.

To remove the used filter elements, set the assembly on a flat surface and compress each spring until the retainer will permit removal of the pin. Lift off the filter element plate and remove the elements from the retainer rods.

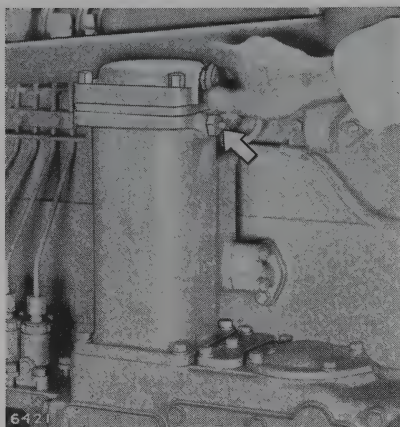
Attaching new filter elements to filter element plate: Thoroughly wash the plate, retainer rods, retainers, pins and springs in clean washing fluid, kerosene, Diesel fuel or a non-inflammable cleaning solvent. **Make sure that the hands are clean before attempting to install the new parts.** Place the retainer rods into each new filter element (two filter elements should be placed on each of the two back retainer rods) and attach to the plate individually by compressing the spring and inserting the pin so that it is held securely in the counterbore of the retainer. Grasp each element at the bottom end and give it approximately a half turn under light pressure to seat the end of the element against the plate and against the disc on the bottom of the retainer rod. Keep the elements parallel and square with the plate while performing this operation.

Installing filter elements in housing: Before installing the elements in the housing, flush out the housing with clean fuel and replace the drain plug. Install the new plate gaskets supplied with each set of elements.

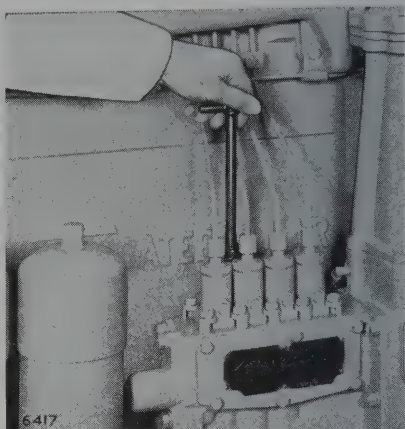
Exercise extreme care to see that the top side of the retainer plate, retainer assembly, and the inside of the housing cover are clean. These parts are on the clean side of the elements and if dirt is not completely removed, it will find its way into the fuel injection equipment. Replace the cover, open the main fuel tank valve and follow the instructions for PRIMING THE FUEL SYSTEM.

An extra set of filter elements should be kept on hand for replacement purposes. Always keep the elements wrapped in their original cartons to insure against dust and dirt accumulations which will shorten the life of the elements if it gets on the outside or may cause damage to the fuel injection equipment if it gets on the inside.

PRIMING THE FUEL SYSTEM



OPENING FUEL FILTER VENT VALVES



OPENING FUEL INJECTION PUMP VENT VALVE

Any time the fuel flow is broken and air is allowed to get into the fuel system, the fuel system must be primed. If air is left in the lines, the fuel system may become air bound, resulting in inability to start the Diesel engine or the missing of one or more cylinders.

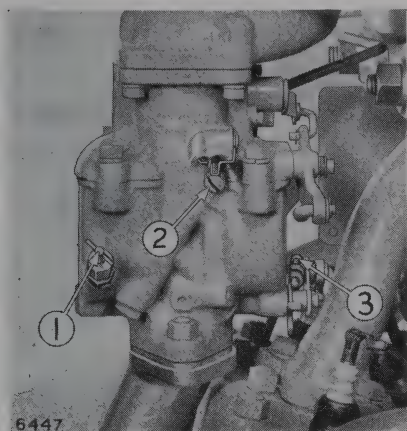
To Prime the Fuel System: Check to see that the main fuel line valve is open, and open both the fuel filter vent valves and the vents on the fuel injection pumps. Then, start the starting engine, engage the starter pinion, and the starting engine clutch. Allow the starting engine to crank the Diesel engine at idle speed, with the compression release lever in the START position, so the fuel transfer pump will force the air and fuel through the fuel filters and the fuel pump vents. The Diesel engine throttle should be in the extreme forward position, so the pumps are shut off. When the flow of fuel through the vents becomes continuous and contains no air bubbles, close the vents. Open and close the vents several times in succession to be sure that all of the air is bled from the system.

STARTING ENGINE FUEL SYSTEM

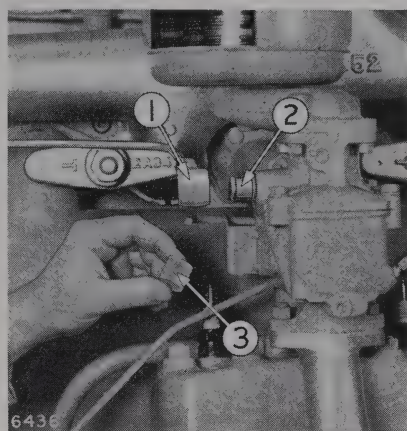
Carburetor Adjustment: To obtain an approximate adjustment, turn the high speed adjusting screw one and three-eighths turns from the closed position. Turn the idling speed adjusting screw one and one-half turns from the closed position. Start the engine and allow it to warm up.

A more accurate adjustment can be obtained by turning the high speed screw out to make the adjustment richer or in to make it leaner. Adjust this screw to a point that will give the greatest amount of power with a clear exhaust. Turn the idling speed adjusting screw to a point where the engine will idle regularly at slow speed without emitting black smoke from the exhaust. Turn this screw in to make the mixture richer or out to make it leaner. Turn the idling speed control screw to the left (out) to decrease the idling speed or to the right (in) to increase it.

Sediment Bowl and Filter: The sediment bowl collects water and sediment that may be in the fuel. To remove the collected water and sediment, close the valve under the fuel tank and remove the bowl by



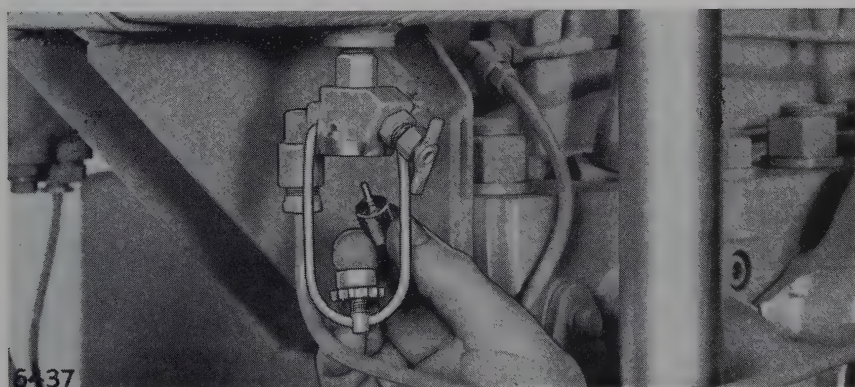
CARBURETOR ADJUSTMENTS
1—High speed adjustment. 2—Idling speed adjustment. 3—Idling speed control screw.



REMOVING FUEL LINE SCREEN
1—Body Assembly. 2—Stud.
3—Screen.

unscrewing the nut that clamps it to the body of the valve. Unscrew the edge-type filter and shake it in kerosene or some non-inflammable washing fluid. When the bowl is replaced see that the gasket is clean, is in the correct position, and is not broken. The fuel line screen in the carburetor should be removed and cleaned whenever the sediment bowl is serviced. This is done by removing the screw that holds the body assembly in place over the screen and stud; then remove the body assembly and slide the fuel line screen off the stud.

Occasionally remove the drain filter on the starting engine inlet manifold and inspect the filter element. If it is deteriorated, replace it.



STARTING ENGINE SEDIMENT BOWL FILTER

CARE OF THE COOLING SYSTEM

Water used in the cooling system should be soft, or as free as possible from scale forming minerals. If it is impossible to obtain soft water, it is advisable to treat the available water with some commercial water "softener."

The cooling system should be drained occasionally to remove dirt and sediment which accumulates. The cooling system is drained by opening the valve on the radiator water outlet elbow on the left side and by removing the drain plug at the rear of the water manifold on the same side of the Diesel engine. This should be done at the end of the day's run when all the material is in suspension and will drain with the liquid. At the same time, the plate at the rear of the starting engine cylinder block should be removed so that the sediment can be cleaned out of the water jacket. During the time the starting engine is not running the velocity of the water around its cylinder block is low allowing the sediment in the water to settle.

The cooling system should be washed out occasionally to prevent accumulation of scale deposits from lowering its efficiency. To do this, run the engine until the liquid in the cooling system is at operating temperature and the loose foreign material stirred up. Then stop the engine and drain it as quickly as possible before the sediment has time to settle. Close the drain and pour in one gallon (3.8 Liters or .8 Imp. Gal.) of kerosene for every 10 gallons (38 Liters or 8 Imp. Gal.) of water required to fill the system. Fill the remainder of the system with a solution of one-half pound (226.8 grams) of washing soda to each gallon of water. Run the engine for one-half hour and again drain and flush the system with clean water.

In more obstinate cases, if the above treatment does not prove effective, an acid solution may be used, but acid must be used with extreme care and only after other means have proved ineffective. **Immediately** after the system has been washed with the soda solution as described above, fill the cooling system with a solution of five parts hydrochloric (commercial muriatic) acid, one part formaldehyde and forty-eight parts of water and allow it to remain in the cooling system for a few hours at operating temperature. The formaldehyde should first be mixed with the water, then the acid added to the solution. **Drain immediately** after stopping the engine and thoroughly flush the system with clean water to which has been added a handful of washing soda which acts as a neutralizing agent.

After using the acid treatment, the cooling system should be drained and flushed with clean water the second time at the end of the day's run.

CAUTION: The acid solution is also a solvent of the metals of which radiators are made. Therefore, great care must be exercised to avoid continuing the operation beyond the point where the scale is dissolved. It is highly important that no trace of the acid be left in the cooling system.

PACKING NUT ADJUSTMENT

Tighten the water pump packing nut by turning it in the direction the shaft turns until the leak stops and then back off 1/6 turn. The packing should be only tight enough to stop any leak but not tight enough to bind the shaft.

VALVE CLEARANCE ADJUSTMENT

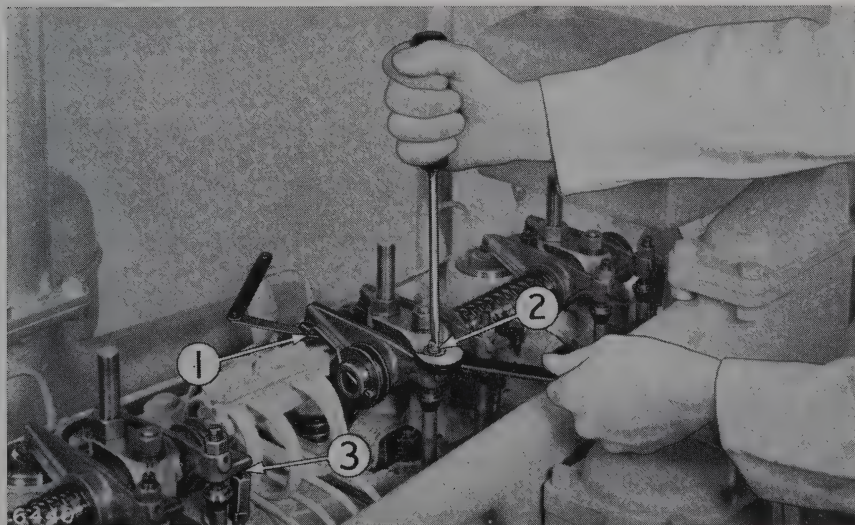
The initial valve clearance adjustment should be made at the time the cylinder head stud nuts are tightened after the first few hours of operation. Then adjust the valve clearance after the next 120 hours of operation. Thereafter, the clearance should be checked and adjusted if necessary after every 240 hour operating interval.

The valve clearance adjustment should be made while the engine is hot, either while the engine is running or before it has been stopped twenty minutes after having run long enough to thoroughly warm up. If the adjustment is made with the engine stopped and is not completed during this twenty minute interval, start the engine and allow it to warm up. The exhaust valve clearance adjustment and the compression release clearance adjustment must be made, or the clearance checked, with the compression release lever in the RUN position.

To Adjust: Loosen the valve adjusting screw lock nut, turn the adjusting screw to allow the thickness gauge to pass between the top of the valve sleeve and the end of the valve rocker at the correct clearance. Set this clearance at .012" (0.30 mm.) for exhaust and inlet valves, with the thickness gauge supplied in the tool equipment. Tighten the adjusting screw lock nut and check the adjustment.

If adjustment is made with the engine stopped, turn the engine until the valve closes and the push rod is at its lowest point.

After adjusting the clearance on the inlet valve, and while the compression release lever is still in the RUN position with the engine stopped, check the clearance between the upper end of the compression release push rod and the end of the valve rocker. This clearance should be .025 to .030 inch (0.64 to 0.76 mm.). To adjust, loosen the lock nut on the compression release push rod and turn the adjusting nut until the correct clearance is obtained. Recheck the adjustment after the lock nut is



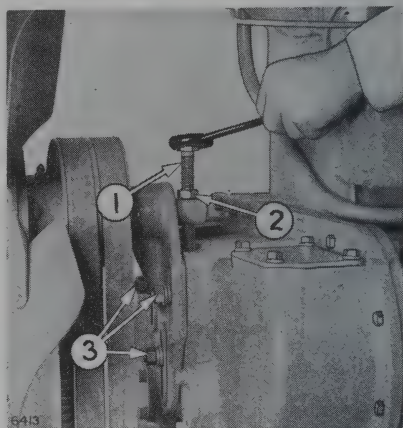
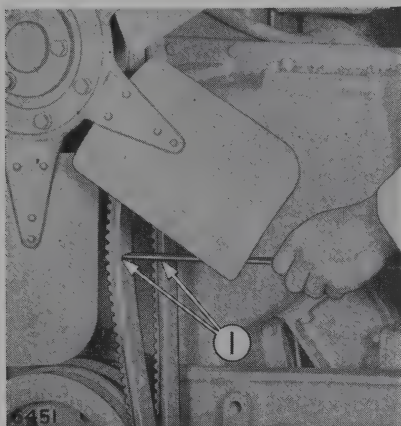
VALVE CLEARANCE ADJUSTMENT

1—There should be .012 inch (0.30 mm.) clearance here. 2—Adjust clearance here. 3—Measure compression release clearance here.

tightened. Check this clearance every time the inlet valve clearance is changed or checked.

Later tractors, beginning with 7M1565, are equipped with two-piece valve covers. These covers permit checking and adjusting valves without removing the engine hood.

FAN BELT ADJUSTMENT



CHECKING FAN BELT TENSION

- 1—Correct adjustment allows approximately $1\frac{1}{2}$ inch (3.75 cm.) slack at this point.

FAN BELT ADJUSTMENT

- 1—Adjusting screw. 2—Lock nut.
3—Retaining nuts.

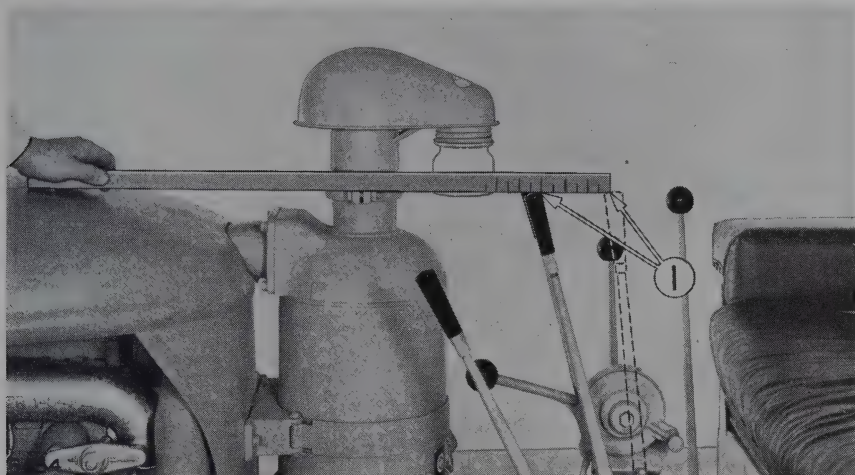
To adjust the fan belts, loosen the three retaining nuts which hold the fan hub bracket to the timing gear case. Loosen the lock nut on the adjusting screw which passes through the fan pulley shaft and turn this screw until the belts can be pushed inward at the center about one and one-half inches (3.75 cm.). Recheck the adjustment after tightening the lock nut and bracket nuts. If the fan belts are operated too loose, they will slap against the pulleys, causing unnecessary wear to the belt and possibly slipping to the extent that the engine will overheat. If the belts are too tight, unnecessary stresses are placed upon the fan bearings and belts, which might shorten the life of both.

STEERING CLUTCH CONTROL ADJUSTMENT

To test the adjustment, measure the amount of free movement at the top of the steering clutch levers. The adjustment is correct when there is 3 inches (7.6 cm.) free movement at this point. To adjust, remove the inspection plate (one for each clutch) from the rear of the steering clutch case. With the engine stopped or the flywheel clutch disengaged the adjustment may then be made.

On machines beginning with 7M5070, loosen the lock nut and turn the adjusting nut on the adjusting screw until the correct free movement is obtained at the top of the steering clutch levers. Then tighten the lock nut without altering the position of the adjusting nut.

On machines before 7M5070, loosen the lock nut on the adjusting screw and turn the adjusting screw until the correct free movement is obtained.



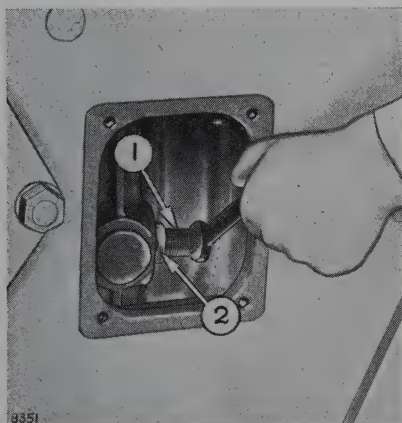
CHECKING ADJUSTMENT OF STEERING CLUTCH CONTROLS

1—There should be at least 3 inches (7.6 cm.) free motion at this point.

Certain type of equipment mounted on the rear of the tractor prevents adjusting the steering clutch control through the openings on the back of the steering clutch case. On machines beginning with 7M5070, this adjustment may also be made through the openings on top of the case through which the steering clutch brakes are adjusted.

If at any time the steering clutches fail to re-engage properly, it most likely will be found that dirt or some solid object lodged between the base of the steering clutch lever and the rubber bumper is holding the hydraulic control mechanism open. Removing the obstruction should correct the difficulty.

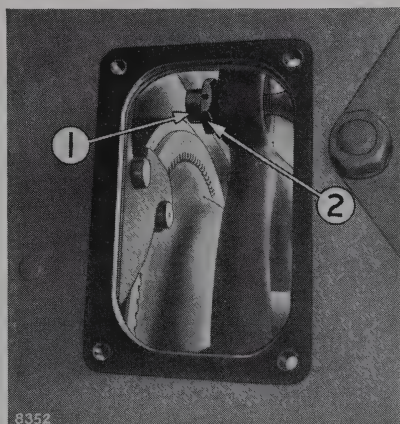
As the steering clutches become sufficiently worn through service to prevent restoring proper control adjustment, consult your "Caterpillar" Dealer regarding further adjustment or repair of the steering clutches.



STEERING CLUTCH CONTROL ADJUSTMENT

EARLY MACHINES

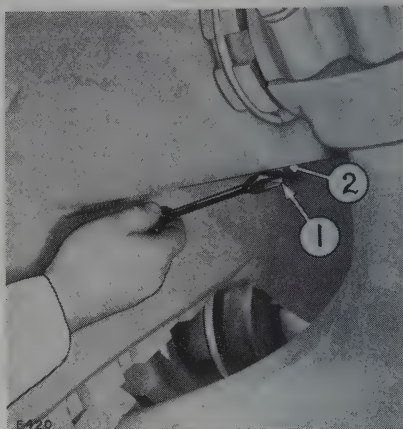
1—Adjusting Screw. 2—Lock Nut.



LATE MACHINES

1—Lock Nut. 2—Adjusting Nut.

STEERING CLUTCH BRAKE ADJUSTMENT

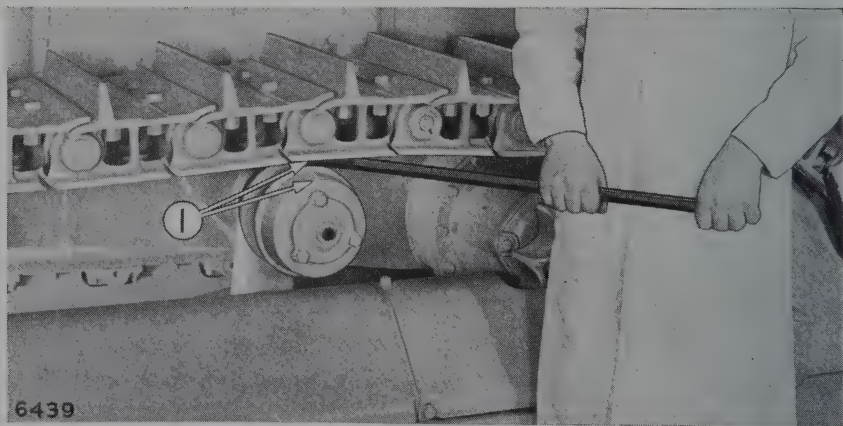
STEERING CLUTCH BRAKE
ADJUSTMENTADJUSTING BRAKE SUPPORT
SCREW

1—Screw. 2—Lock nut.

Keep the brakes adjusted just tight enough so the tractor will turn correctly when the steering clutch is released and the pedal is depressed about three-fourths of the way to the floor plate. The band should be entirely free from the drum when the pedal is in the released position.

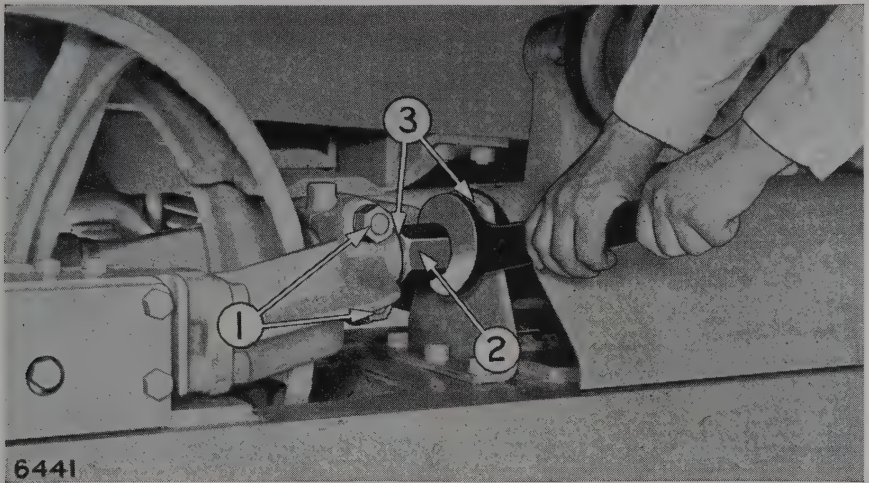
To adjust, remove the inspection plate located on either side immediately back of the seat and on top of the steering clutch case. Turn the head of the adjusting screw in a clockwise direction to tighten the brakes. Loosen the lock nut on the support screw on the under side of the steering clutch case below the brake drum. Turn the support screw up tight against the band then back off $1\frac{1}{2}$ turns and tighten the lock nut. This screw supports the brake band and maintains the correct clearance between the lining and the drum.

TRACK ADJUSTMENT



CHECKING TRACK TENSION

1—There should be $1\frac{1}{2}$ to 2 inches (3.8 to 5.1 cm.) clearance at this point.



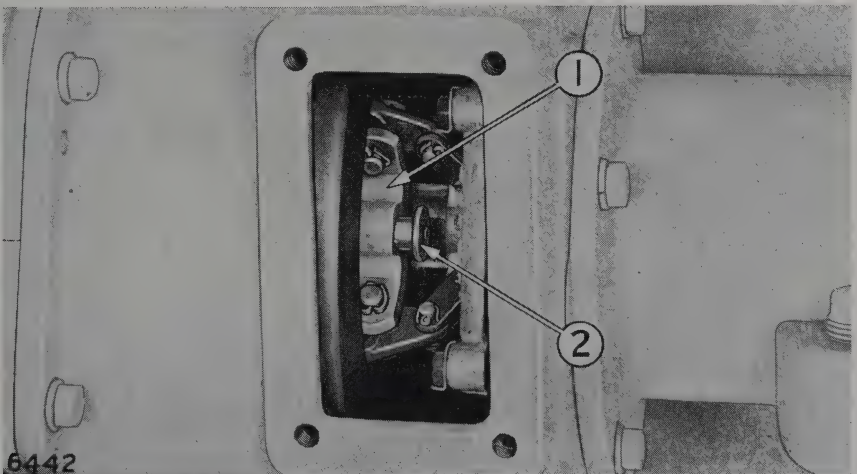
ADJUSTING TRACK TENSION

1—Clamp nuts. 2—Adjusting screw. 3—This measurement should not exceed $8\frac{1}{4}$ inches (20.9 cm.)

The track adjustment is correct when the track may be raised from $1\frac{1}{2}$ to 2 inches (3.8 to 5.1 cm.) above the track carrier roller. To adjust the track, remove the cover back of the front idler and loosen the clamp nuts on the front idler arms. Turn the adjusting screw until the track is at the correct tension. When the adjustment has been made, drive the tractor backward and forward to equalize the adjustment. Then, recheck the tension. Tighten the clamp nuts and replace the cover.

As continued track adjustment becomes necessary through service, the following precaution should be observed to prevent the adjusting screw being screwed out of the nut at the front of the recoil spring, with subsequent damage to the threads: A maximum measurement of $8\frac{1}{4}$ inches (20.9 cm.) should not be exceeded between the adjacent faces of the guide assembly and the front idler arms.

STARTING ENGINE CLUTCH ADJUSTMENT



STARTING ENGINE CLUTCH ADJUSTMENT

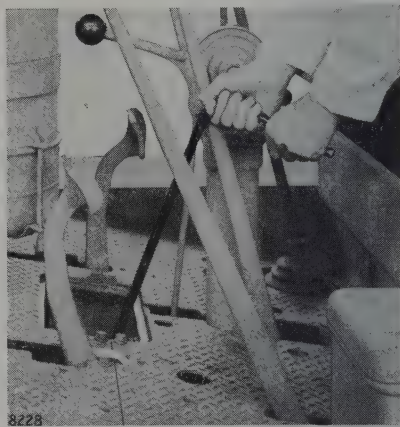
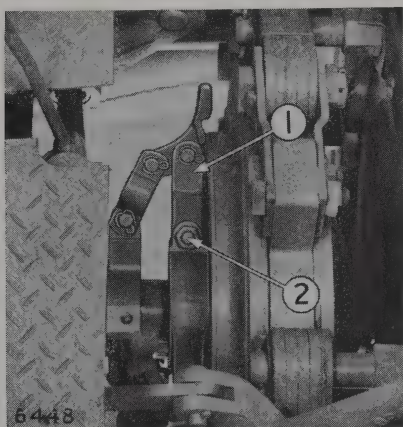
1—Adjusting collar. 2—Lock pin.

To Test: Pull the clutch lever to the engaged position. The lever should go into this position with a distinct snap, and should require a reasonably hard pull.

To Adjust: Remove the plate from the side of the clutch compartment. Turn the clutch adjusting collar until the lock pin is accessible. Pull the lock pin out and turn the collar to the right until the lock pin drops into the next hole. Test the adjustment by engaging the clutch. If one hole gives a slightly loose adjustment and the next gives too tight an adjustment, use the looser adjustment. Test the clutch frequently and adjust when necessary. If oil is noticed in the housing, remove the plug underneath and drain the compartment.

FLYWHEEL CLUTCH ADJUSTMENT

To Test: Pull the clutch lever to the engaged position. The lever should engage with a distinct snap, and should require a reasonably hard pull.



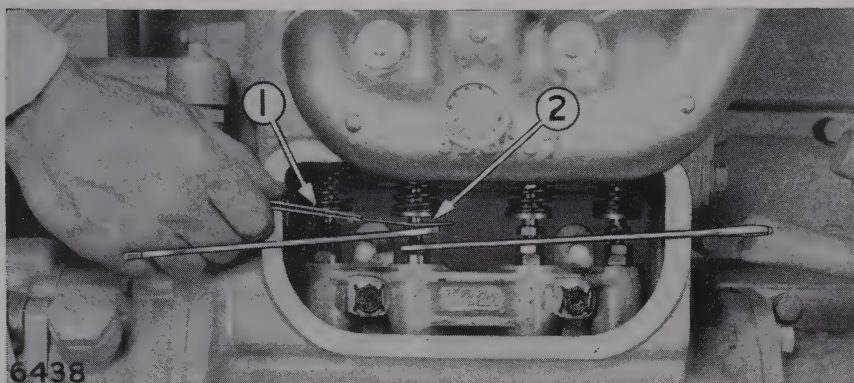
FLYWHEEL CLUTCH ADJUSTMENT
1—Adjusting collar. 2—Clamp bolt.

To Adjust: Disengage the clutch and remove the inspection cover from the clutch housing; on early tractors without enclosed clutch, lift up the hinged cover at the front of the floor plate. Loosen the nut on the adjusting collar clamp bolt and with the transmission gears engaged, turn the collar a few degrees in a clockwise direction; then tighten the clamp bolt with the clutch disengaged. Repeat this adjustment until the desired clutch snap is obtained. Replace the inspection cover and disengage the transmission gears.

The length of the adjustable rod between the flywheel clutch control lever and the crank assembly that actuates the clutch yoke should not be changed as its length, which is set at the factory, has a definite bearing on the timing and satisfactory operation of the transmission locking device.

STARTING ENGINE VALVE CLEARANCE ADJUSTMENT

The valve clearance adjustment should be made when the engine is hot. To adjust, crank the engine until the valve closes and the valve-lifter is at its lowest position. Loosen the lock nut on the adjusting screw



STARTING ENGINE VALVE CLEARANCE ADJUSTMENT

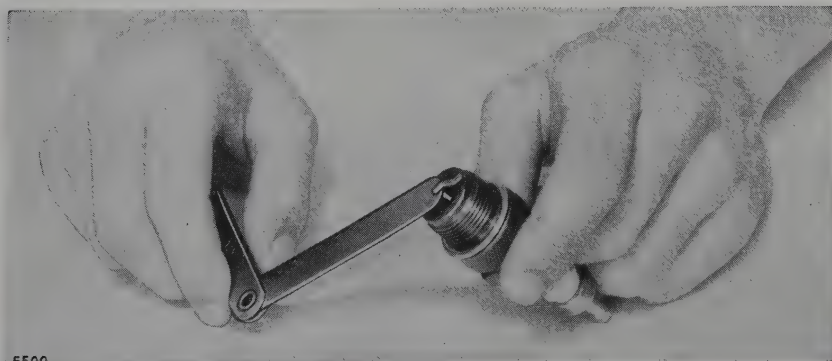
1—Thickness gauge. 2—There should be .008 inch (0.2 mm.) clearance at this point.

and turn the screw until there is .008 inch (0.2 mm.) clearance between the end of the valve stem and the head of the adjusting screw. Recheck the adjustment after the lock nut is tightened.

STARTING ENGINE SPARK PLUG ADJUSTMENT

The spark plugs should be examined often enough so that the gap may be kept at approximately .022 inch (0.56 mm.). Measure this gap with the thickness gauge supplied with the tool equipment. To adjust the gap, bend the outer electrode.

The side electrode of a spark plug will wear in a curved or arched manner, at a point immediately above the center electrode, after some service. For this reason, a round wire gauge, obtainable from spark plug manufacturers, should be employed to determine proper gap for used spark plugs.



STARTING ENGINE SPARK PLUG ADJUSTMENT

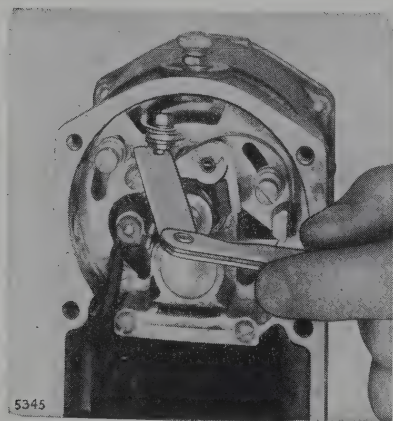
STARTING ENGINE MAGNETO

Every 600 hours of operation, oil the impulse starter through the cup on top of the magneto drive housing. A few drops of oil is ample.

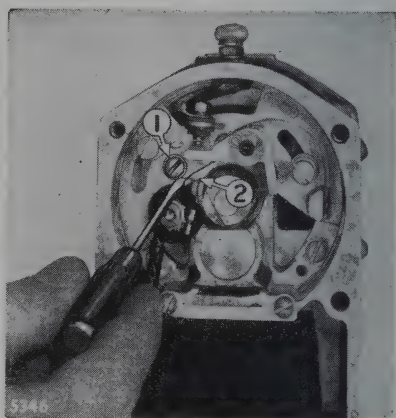
While flushing out the impulse starter is not periodically necessary, it is well to clean it thoroughly at a time when the magneto is removed for adjustment or repair.

Do not lubricate the magneto at any point. The bearings of this magneto are packed with a special, high melting point lubricant when assembled, and this should be replaced only when the magneto is taken to an Eisemann Service Station for checking or reconditioning.

Adjusting of Contact Points: Every 1200 hours check the contact point opening.



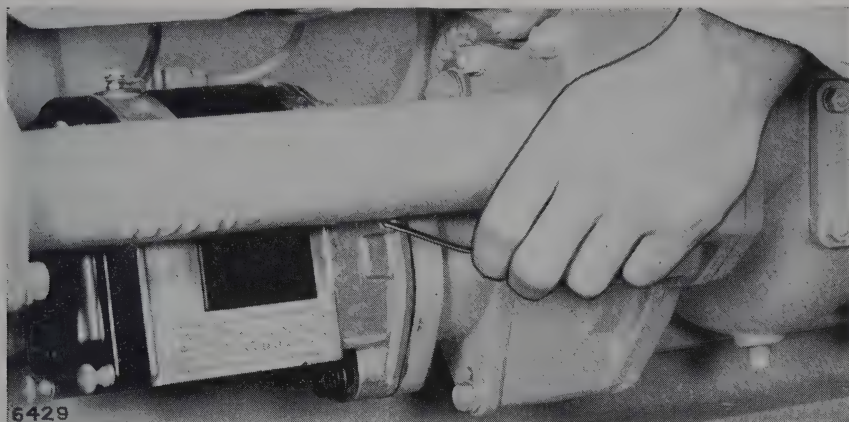
CHECKING CONTACT POINTS



ADJUSTING GAP
1—Screw. 2—Lip on bracket.

To Check: Remove the distributor plate and lift out the distributor rotor; then release the impulse starter pawl. This is done by removing the plug screw in the side of the magneto housing and inserting a nail or stiff wire in the hole as the engine is cranked slowly. The nail depresses the short end of the pawl and releases it from the catch plate.

Turn the crank until the bumper block is on the highest elevation of the cam. Check the clearance with the thickness gauge supplied in the tool equipment. This should be .020 inch (0.51 mm.).



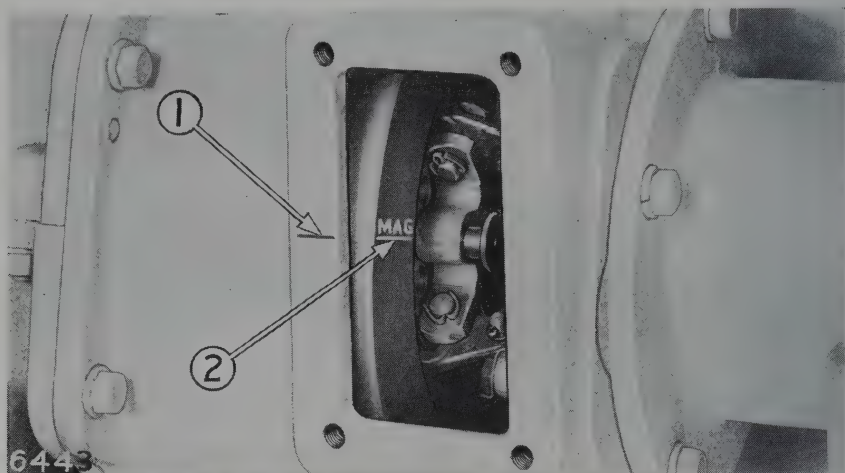
TRIPPING IMPULSE STARTER PAWL

To Adjust: Loosen the screw which secures the adjustable contact point bracket and move the bracket by inserting a screwdriver in the space between the head of the screw and the lip on the bracket. Then tighten the screw and recheck the adjustment.

Testing: A magneto may be tested when coupled to the engine by turning the switch ON, removing the cable from the spark plug, and holding the terminal $\frac{1}{8}$ inch (3.17 mm.) away from the metal part of the plug while the engine is being cranked. If no spark passes from the cable to the plug body, disconnect the magneto switch wire from magneto and test again. If the magneto fails to fire, remove the magneto, cables, spark plugs, and switch and take them to the nearest Eisemann Service Station for testing. See the list of Eisemann Service Stations accompanying the tool equipment or consult your "Caterpillar" Dealer.

To Remove Magneto: Disconnect the cables from the distributor plate and the wire from the switch. Remove the ignition wire conduit by removing the metal tube that is attached to the engine. Remove the magneto by removing the cap screws that hold it in place.

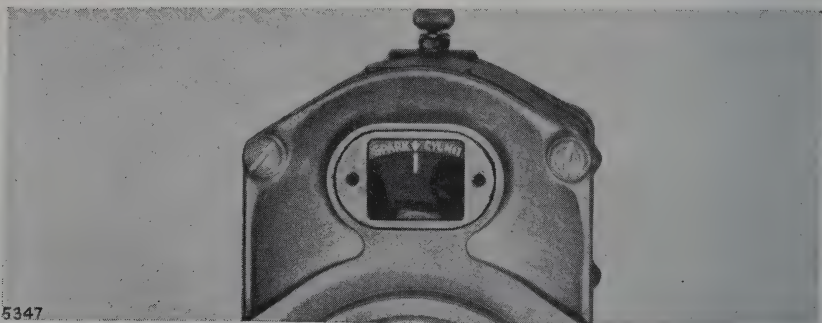
To time the magneto to the engine: Carefully check the contact points for the proper opening. Locate the firing point of No. 1 cylinder by removing the cover from the side of the starting engine clutch housing and the spark plug from No. 1 cylinder. Hold a finger over the spark plug hole and turn the crank slowly until a rush of air is noted coming from the cylinder. This indicates that the piston is coming up on the compression stroke. Observe the side of the flywheel, and turn the crank slowly until the mark "MAG" is even with the mark on the housing. The crank on No. 1 cylinder is now 25° ahead of top dead center on the compression stroke which is the correct firing point.



STARTING ENGINE MAGNETO TIMING MARKS

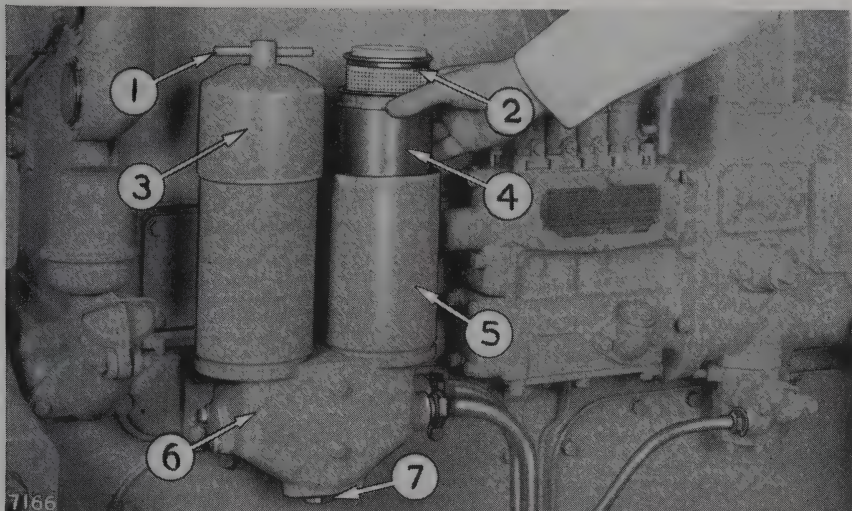
1—Mark on the housing. 2—Mark on the flywheel.

Remove the magneto from the engine; after which the small cover at the end of the magneto should be removed by taking out the two small fastening screws. Release the impulse starter pawls and turn the magneto shaft until the white line on the distributor gear lines up with the pointer in the end plate casting. At this point the distributor rotor should be in contact with the conductor which is connected by wire to the spark plug of No. 1 cylinder, and the contact points should be barely separated. Slide the magneto into position and bolt in place. Check the location of the rotor before replacing the rear cover to be sure it has not changed its position.



MAGNETO TIMING MARKS

CRANKCASE LUBRICATING OIL FILTER



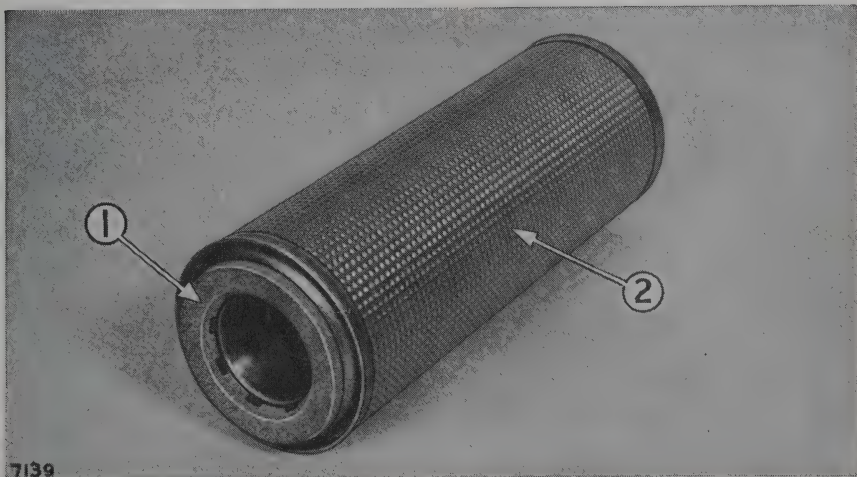
CRANKCASE LUBRICATING OIL FILTER

1—Clamp bolt. 2—Inner element. 3—Cover. 4—Outer element.
5—Housing. 6—Sludge compartment. 7—Drain plug.

While the oil is draining from the crankcase and oil cooler, remove the drain plug from the oil filter base. Then loosen the clamp bolt and remove the cover and clamp bolt as a unit.

Lift out the inner and outer filter elements. Remove the inner elements and discard them.

Wash the covers, outer filter elements, housings and sludge compartment with kerosene or some non-inflammable cleaning fluid, and allow them to drain.



LUBRICATING OIL FILTER INNER ELEMENT

1—Cork seals. 2—Perforated metal cover containing absorbent filter material.

Reinstall the outer elements, and new inner filter elements. Then replace the covers and tighten the clamp bolts.

Servicing the crankcase lubricating oil filter as described should be performed each time the crankcase is drained.

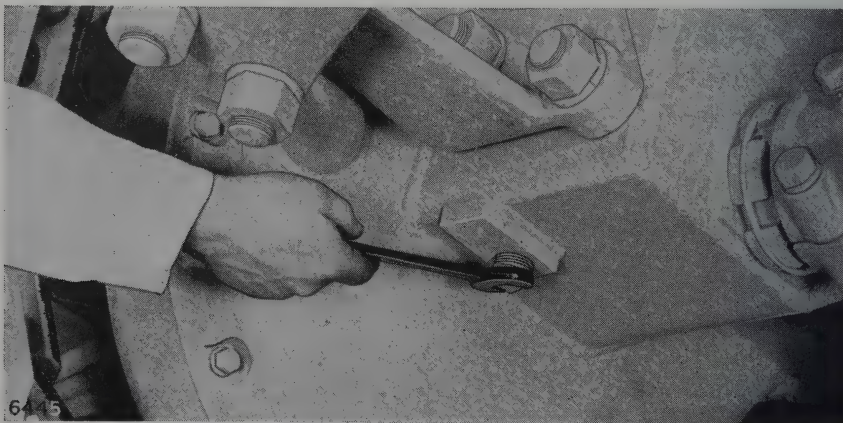
WASHING THE CRANKCASE

Wash or flush the crankcase occasionally to remove the foreign particles that accumulate there. At a time when it is necessary to change the crankcase lubricating oil, drain the crankcase while the engine is hot. Replace the drain plug and pour two gallons (7.6 liters, or 1.7 Imp. Gal.) of flushing oil into the crankcase. Run the engine for three minutes, noting that the lubricating oil pressure gauge shows pressure. Then drain the flushing oil. **If sludge is noticeable when draining the crankcase, the oil pump screen should be inspected and cleaned if necessary.** This screen can be reached by taking off the cover on the left side of the oil pan. The flushing oil may be used over again if the foreign matter is allowed to settle and then removed.

To Wash the Starting Engine Crankcase: Remove the drain plugs while the engine is warm. Replace the plugs and refill the crankcase with 1½ quarts (1.4 liters, or 0.31 Imp. Gal.) of flushing oil. Run the engine 3 minutes and drain. Refill with fresh oil of the correct viscosity. See topic, LUBRICATION INSTRUCTIONS.

DRAINING THE STEERING CLUTCH COMPARTMENTS

The steering clutches are designed to operate dry. Oil is used only to lubricate the release bearings. This oil, and any seepage from the adjoining compartments should be drained every 60 hours of operation by removing the plugs from the bottom of the case. If the compartments



REMOVING STEERING CLUTCH COMPARTMENT DRAIN PLUGS

are not drained at regular intervals oil may work into the steering clutches enough to cause slippage or difficult steering. The drain plugs should be replaced to insure against the entrance of dirt and moisture.

WASHING THE TRANSMISSION

Remove the drain plug from the speed change compartment, and the bevel gear compartment after a run when the oil is warm. Replace the plugs and fill to the level mark on the bayonet gauge with kerosene or some non-inflammable washing fluid. The oil in the bevel gear compartment adjusts itself to the level in the speed change compartment through a connecting passage.

With the engine running, move the speed selector lever to the neutral position, shift the forward and reverse lever into either gear and engage the flywheel clutch. Allow the gears to run for five minutes and then shift the forward and reverse lever into neutral. Stop the engine and drain the compartments thoroughly, also clean the magnets thoroughly in each of the drain plugs. Replace the drain plugs and refill with fresh transmission oil. See topic, LUBRICATING INSTRUCTIONS.

DRAINING THE FLYWHEEL CLUTCH HOUSING

(Enclosed Type)

The clutch plates are designed to operate dry. The plug on the bottom of the flywheel housing, directly under the flywheel clutch should be removed every 60 hours to drain any oil that may have seeped into the compartment from the engine, transmission, shift or sliding collars. If oil from these points is allowed to accumulate, the clutch plates may become sticky and cause difficult operation of the clutch.

WASHING THE FINAL DRIVE CASES

Remove the drain plugs from both cases after a run when the oil is warm and allow the old oil to drain. Replace the plugs and fill the cases to the level of the filler hole with kerosene or some non-inflammable washing fluid. Drive the tractor back and forth for five minutes and remove the drain plugs. After all the washing fluid has drained, replace the plugs and fill to the correct level with fresh transmission oil. See the topic, LUBRICATING INSTRUCTIONS.

WASHING THE STARTER PINION SHAFT HOUSING

Remove the drain plug from the under side of the housing and allow the old oil to drain. Replace the plug and fill the housing to the level of the top of the filler elbow with kerosene or some non-inflammable washing fluid. Allow the washing fluid to stand for 5 or 10 minutes then drain and refill with fresh oil.

THE WORKING PROCESS

The "Caterpillar" Diesel operates on the 4-stroke cycle, compression-ignition principle, and burns fuel commercially known as Diesel fuels, without the assistance of spark plugs or externally heated surfaces. In explaining the working process, the inlet stroke is the most convenient point at which to begin.

Stroke 1: As the piston moves downward on the inlet stroke, air is drawn through the air cleaner, passing through the inlet valve, into the main combustion chamber. Unlike the spark ignition engine, the Diesel always takes in a full charge of air on each inlet stroke, whether operating at idling speed or full load.

Stroke 2: On the compression stroke, both the inlet and exhaust valves are closed, and the piston moves upward, crowding the air within the cylinder into an extremely small space. When the piston reaches top center, the air is compressed to 600 pounds per square inch. This high compression causes the air to reach a temperature of over 1000° F. (538° C.). When the fuel is sprayed into this highly heated air it will ignite and burn readily. While the air is being compressed in the main cylinder, highly heated air currents pass into the pre-combustion chamber. This air is set aside to ignite the fuel.

Stroke 3: Near the end of the compression stroke, and at the beginning of the power stroke, the fuel pump forces a measured quantity of fuel through the fuel line, into the fuel injection valve, which sprays it into the pre-combustion chamber. This fine spray heats quickly and ignites. As more fuel is injected, it is enveloped by flame, becomes gasified, and travels through the opening into the main combustion chamber, where additional air is available to complete its combustion. Power is thus obtained, and the piston is forced down by the pressure of the expanding and burning gas above it.

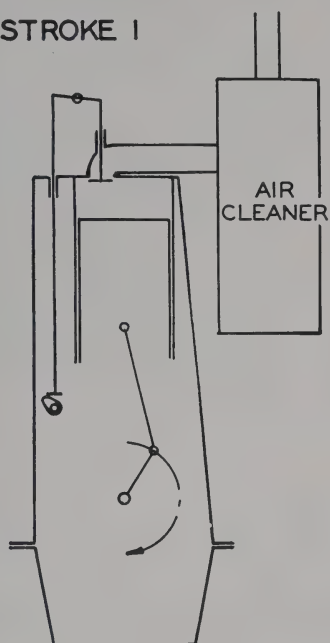
Stroke 4: As the piston moves upward on the exhaust stroke, the exhaust valve opens, and the burned gases are forced out through the exhaust pipe.

A smoky exhaust means inefficient engine output indicating that fuel is passing through the engine without being burned. This may be due either to overloading the engine or faulty fuel injection equipment. Continued operation under these conditions may cause abnormal wear to working parts of the engine resulting in less service being obtained than might normally be expected. For this reason, never overload the engine or permit continued operation with improperly functioning fuel injection equipment.

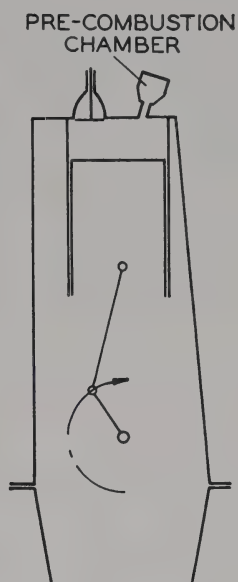
TESTING THE FUEL INJECTION EQUIPMENT

As the clearance between the plunger and the barrel of the fuel injection pump increases, due to wear, fuel leakage occurs. If the leakage increases to the point where insufficient fuel is injected into the cylinder, a loss of power may be noticeable. With the loss of power, hard starting may also be encountered.

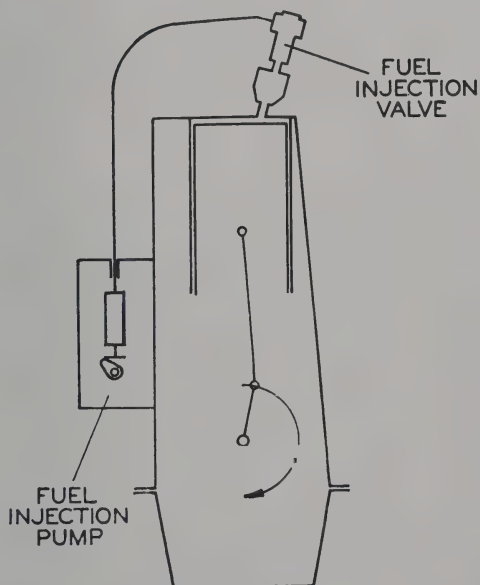
STROKE 1



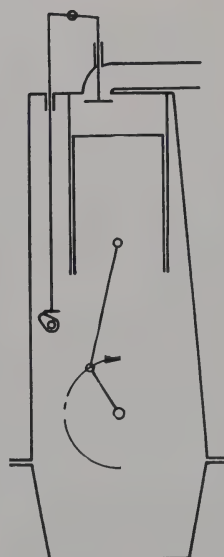
STROKE 2

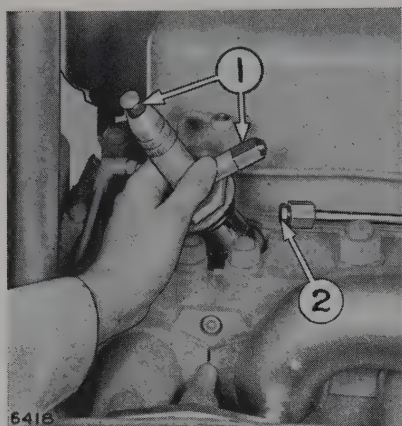


STROKE 3



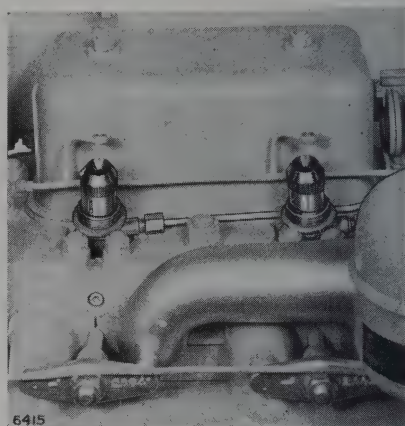
STROKE 4





INJECTION VALVE REMOVED

- 1—Cover for fuel injection valve.
2—Plug for fuel injection line.

TESTING FUEL INJECTION
VALVES

When improper fuel injection is affecting the Diesel engine operation, a systematic check should be made to determine the cause. The most likely cause is dirt or water in the fuel. Drain the sediment from the fuel tank. Replace the absorbent fuel filters if necessary. Then prime the fuel system until clean fuel passes through the vent valves on the fuel injection pumps. If the fuel system is air bound, priming the system will overcome the difficulty.

When an engine is running irregularly, and smoking, it may be that a fuel injection valve is not spraying the fuel properly, allowing some of it to pass into the exhaust without being completely burned.

Whenever an engine performs in such a manner that a fuel injection pump or a fuel injection valve is suspected of causing the trouble, remove all of the fuel injection valves, and test them. Use the brush supplied in the tool equipment to clean all dirt from around the valves. Disconnect the fuel injection lines and the fuel drain lines and unscrew the retaining nut that holds each valve in place. Turn the valves to a vertical position and connect them to the fuel lines.

Start the starting engine and engage the starter pinion and clutch. Allow the starting engine to turn the Diesel engine at low idle speed. Open the Diesel engine throttle wide, and notice the fuel spray that comes from the fuel injection valves.

If the fuel injection valves give a fine, even spray, it can be assumed that they are in good condition. On the other hand, a fuel injection valve should be replaced if it exhibits any of the following characteristics:

Fuel discharged in a solid stream or jet.

Fuel spray emitted all on one side of the nozzle.

Cut-off at the end of the fuel discharge is sluggish or erratic.

Severe dribble from the nozzle, indicated by large globules of oil wetting the cone nut on the bottom side of the nozzle.

In checking fuel injection valves and pumps, remember that the **quality** of the spray is determined by the condition of the fuel injection valve, while the **quantity** of the spray in a properly operating valve is determined by the condition of the fuel injection pump.

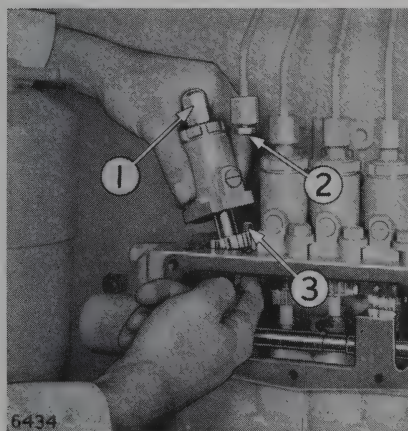
It is not usual for one pump on an engine to require replacement unless all the pumps are worn. Occasionally, however, a single fuel injection valve may be effected by dirty fuel and require replacement, while the other valves in the engine are satisfactory.

When installing fuel injection valves, the retaining nut should be drawn down only tight enough to prevent leaks between the valves and the valve seats.

Removing fuel injection pumps: Every precaution should be taken to prevent dirt from getting into the fuel injection pumps or housing. Use the brush supplied in the tool equipment to clean the top of the housing and around the inspection plate before removing. When fuel injection pumps are removed the pump plungers must not be taken from the barrels as any dust or dirt will score these finely finished parts.

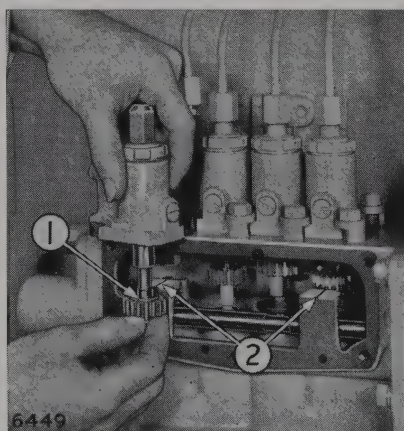
The end pumps (No's. 1 or 4) may be removed without disturbing the other pumps, but neither of the center pumps (No. 2 or 3) should be removed until the pump next to it has been taken out.

After cleaning the top of the housing, and around the inspection plate, remove the fuel injection lines from the pumps and immediately cap the openings with covers provided in the tool equipment. Remove the inspection plate. Remove the fork that fastens the rack to the slide



REMOVING FUEL INJECTION PUMP

1—Pump cover. 2—Fuel line plug.
3—Ferrule cap seal.



1—MARKED TOOTH OF PUMP GEAR. 2—MARK ON HOUSING FOR END PUMPS

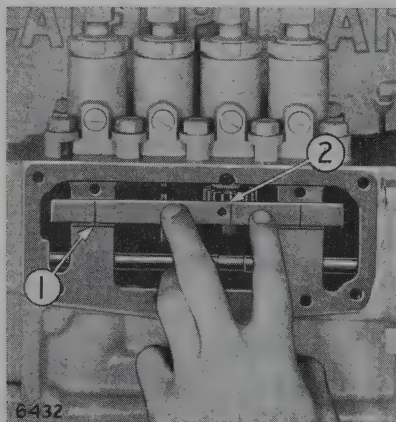
bar. Remove the two capscrews and plates that hold the rack in place and pull the rack out of the housing.

Remove the capscrews and clamps that hold the fuel injection pump to the housing and lift the pump straight up only enough to clear the dowel pins. Then insert a finger through the inspection hole to hold the plunger from dropping out and shift the pump to one side so that the end of the pump plunger will free itself from the slot in the lifter; then remove the pump. Place the rubber ferrule cap seals furnished in the tool equipment over the fuel outlet to protect it from dirt.

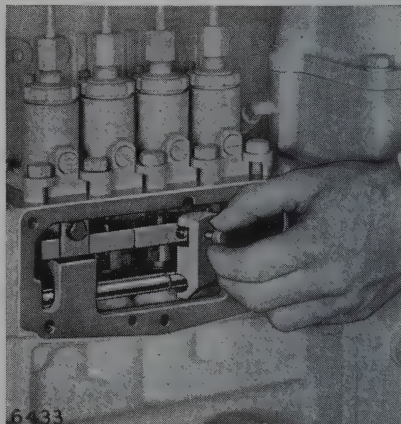
Should the plunger accidentally be removed from the pump barrel, take every precaution to avoid nicking or scratching it since the slightest rough spot will cause undue wear in the barrel and shorten the life of the pump. The plunger should be rinsed in clean fuel before putting it back in the barrel. Be sure the plunger is replaced in the barrel from which it was withdrawn. **Each fuel injection pump assembly (plunger and barrel) is machined as a unit and finished to such exact limits that it must be used, removed, and replaced as a unit.**

Installing fuel injection pumps: Lower the pump and plunger into the housing, taking care that the pump plunger does not slide out of the pump. Slide the end of the plunger into the slot in the lifter. Lower the pump onto the dowel pins and fasten in place.

Turn the gears on the pump plungers until the marked tooth of each gear faces outward toward the pump rack. Replace the pump rack engaging the marked teeth of the pump plunger gears with the marked rack teeth. The end pumps can be aligned with the marks on the fuel pump housing. The other two pumps can be aligned quite easily as the rack is slid into position. After the rack has been slid into position it is advisable to pull the rack out again to see that the marks are correctly aligned. Install the capscrews and plates holding the rack in place. Open the throttle and fasten the fork in place. Replace the inspection cover and connect the fuel lines.



REPLACING FUEL PUMP RACK
1—Align rack marks with housing marks. 2—Align marked gear teeth with grooves on rack.



REPLACING PUMP RACK
FORK

Attachments
for
"CATERPILLAR"
DIESEL D7 TRACTOR

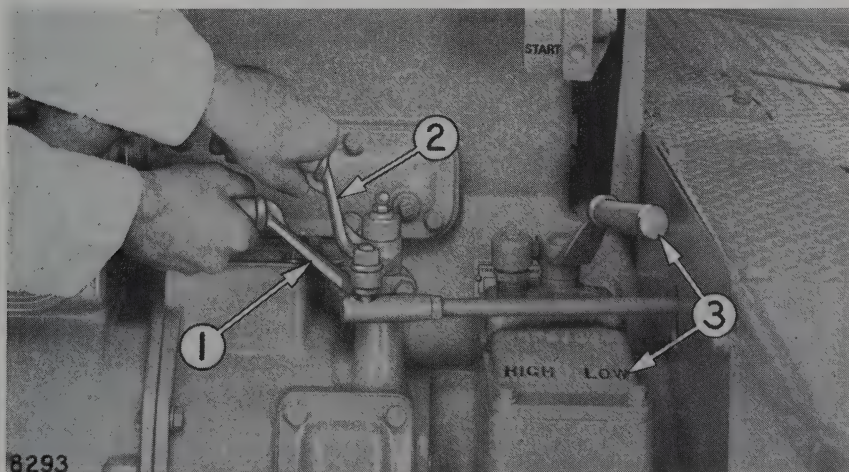
Special Instructions

OPERATING THE STARTING ENGINE TRANSMISSION

Aside from the following information, starting a Diesel engine equipped with a starting engine transmission will be the same as that outlined under the topic, **STARTING THE DIESEL ENGINE**.

During cold weather, or any time the oil "drag" in the Diesel engine slows down the starting engine so the normal cranking speed cannot be reached, the starting engine transmission will be found quite beneficial.

To start a cold engine disengage the starting engine clutch and shift the starting engine transmission into LOW. Engage the starting engine clutch and allow the starting engine to turn the Diesel engine until it turns freely. Then move the compression release lever to the RUN position and allow the starting engine to turn the Diesel engine for several minutes as the heat of compression will assure easy starting. Then move the compression release lever to the START position, disengage the starting engine clutch, shift the starting engine transmission to HIGH and engage the clutch.

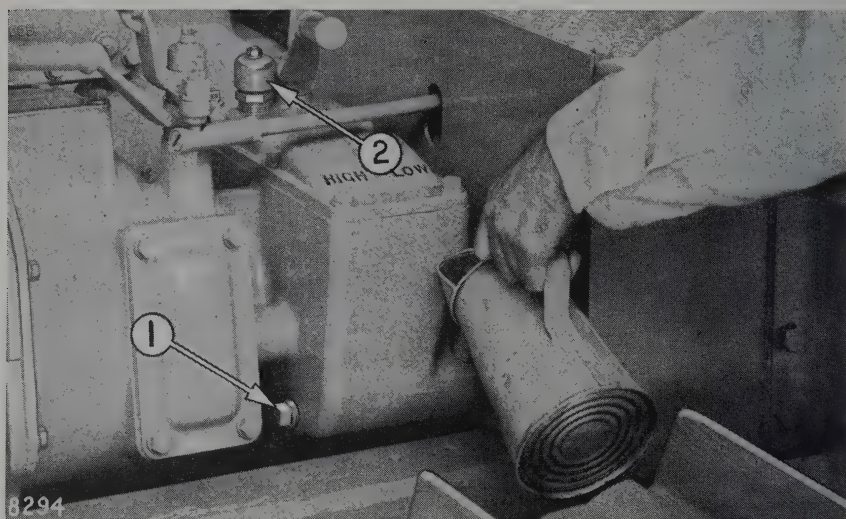


1—ENGAGING STARTING ENGINE CLUTCH. 2—ENGAGING STARTER PINION. 3—STARTING ENGINE TRANSMISSION IN "LOW."

Lubrication and Maintenance: Check the oil level occasionally and keep "full" to filter plug opening with transmission oil. For grade of transmission oil to be used under varying temperature conditions, refer to the topic, LUBRICATING INSTRUCTIONS.

Every 900 hours, drain the transmission case and wash it. To do this, remove the drain plug after the starting engine has been turning the transmission gears and has warmed the oil. After the oil has drained, replace the plug and fill to the correct level with kerosene or some non-inflammable washing fluid. Allow the starting engine to turn the transmission gears for several minutes, then remove the drain plug. After all the washing fluid has drained, replace the plug and fill with fresh transmission oil to the filler opening level.

Periodically remove the small breather located at the back of the transmission case top cover. Disassemble and wash all parts thoroughly. Replace any parts that show evidence of deterioration.



FILLING STARTING ENGINE TRANSMISSION
1—Drain plug. 2—Breather.

LIGHTING SYSTEMS

There are certain factors that must be considered to obtain lasting, efficient operation from a lighting system. Where the system uses a battery, it should be kept well charged as determined by frequent tests and all connections of the electrical system should be kept clean and tight to prevent current losses.

The generator brushes, and brush holders should be kept clean and in satisfactory operating condition.

For information on these subjects, refer to the related topics contained in this book.

OPERATING ELECTRIC STARTING MOTOR

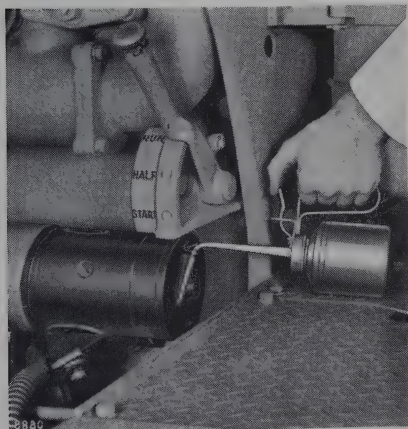
To start the starting engine with the electric starting motor, place the Diesel and starting engine controls in the same position as described in the topic, **STARTING THE DIESEL ENGINE**. Then crank the engine with the electric starting motor by moving the control lever back to engage the drive gear, at the same time contacting the starter switch.

In some instances, when attempting to engage the starting motor drive, it will be found that resistance to movement of the starting motor control lever occurs before the starter switch is contacted. This is due to the starter sliding gear failing to mesh properly with the mating gear on the flywheel of the starting engine. To correct, pull out on the knurled knob of the gear rocker, located in the starter housing, and turn the knob until the sliding gear meshes, permitting continued movement of the control to contact the starter switch.

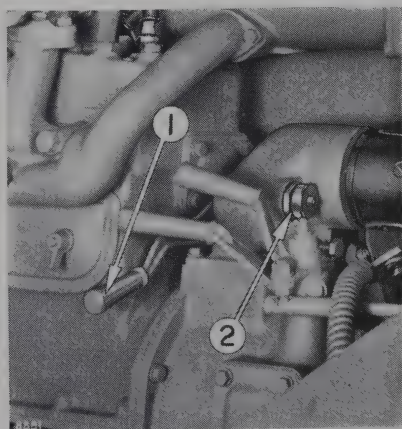
Starting Motor Drive: If difficulty is experienced with the starting motor drive failing to engage with the sliding gear, most probably dirt in the grooves of the starter drive shaft is responsible. To correct, remove the starting motor from the mounting bracket, then take off the starting motor drive housing. Carefully clean the end of the drive shaft of any accumulations of dirt or grease. Wash the spiral sleeve upon which the pinion operates, also the springs, gear teeth and drive housing.

Before installing the drive, lubricate the spiral sleeve with a few drops of light oil, also the housing bushing. Then reassemble and install.

When washing the starting motor drive, the pinion teeth should be inspected and if chipped or damaged, the pinion should be replaced. Likewise, other parts of the starting motor drive showing evidence of being badly worn should be replaced to prevent possible difficulty during operation.



LUBRICATING STARTER



STARTER CONTROLS

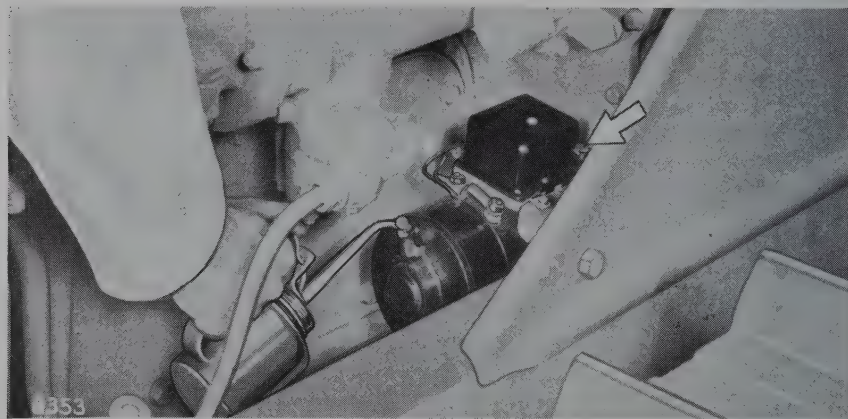
1—Control lever. 2—Drive gear rocker.

CARE OF GENERATOR AND STARTING MOTOR

Cleaning: Approximately every 1,200 hours, the inspection cover should be removed and a check made of the commutator. If it is glazed or darkened, polish with "00" sandpaper. Reverse the sandpaper to clean the contact surface of the brushes. Make certain all trace of sand particles is removed from the commutator, brushes, and brush holders by blowing out with air or by an equally effective method.

Brush Replacement: Brushes should be inspected and replaced if badly worn. When a new brush is installed, seat it properly with the contour of the commutator by using "00" sandpaper. Only a second or two is required to do this. Remove all sand particles and make certain the connections are all tight. A poor connection in the charging circuit will cause the generator to build up excessive voltage which may result in burned field or armature windings. A poor connection in the generator field circuit will cause a low voltage.

General Reconditioning: Approximately every 4,000 hours, the generator and starting motor should be removed so that it may be completely disassembled, washed and have all parts replaced that show



LUBRICATING GENERATOR

evidence of being unsatisfactory for reason of wear. It is suggested that this cleaning and reconditioning be entrusted to an automotive electrical service station that is an authorized dealer of the manufacturer.

Lubrication of Generator and Starting Motor: Clean the dirt from the oil cups before lubricating to keep the dirt out of the bearings. Every 120 hours, lubricate the generator and starting motor bearings with two or three drops of S.A.E. No. 30 straight mineral crankcase lubricating oil.

Never put oil or grease on the commutator.

Some generators have the bearings packed with high melting point lubricant making lubrication necessary only when the generator is disassembled for cleaning or repair.

CARE OF THE BATTERY

Every 60 hours, the following attention should be given the battery to insure high efficiency and maximum operating life:

The battery should be tested with a hydrometer and kept within a margin of safety to a specific gravity of 1.275 to 1.300. A dangerously low point of charge is indicated by a hydrometer reading of 1.150 which will permit the battery to freeze. A specific gravity of 1.250 will permit the battery to withstand temperatures as low as -30° F., without freezing.

Water that escapes by evaporation should be replaced with distilled water or "approved water" (water free from impurities by analysis). The level should be maintained $\frac{3}{8}$ " above the top of the separators or insulators. Do not overfill or underfill the cells of the battery as either has a detrimental effect on battery life.

Always test a battery for degree of charge before adding water, otherwise, it will be necessary to operate the tractor for a short period to charge it; thus allowing the water to mix with the electrolyte.

If when making weekly tests the battery shows evidence of becoming gradually undercharged, it should be removed and completely recharged.

Check to determine the reason for the battery becoming undercharged. Inspect battery terminals and other points in the wiring. A loose connection or worn insulation may be the reason. Also check for an improperly functioning voltage regulator. Refer to the topic, VOLTAGE REGULATOR.

Keep the top of the battery clean and dry to prevent current losses. Also keep the battery hold-down connections tight.

The battery terminal should be kept clean and tight and corrosion prevented by covering the terminals lightly with vaseline.

VOLTAGE REGULATOR

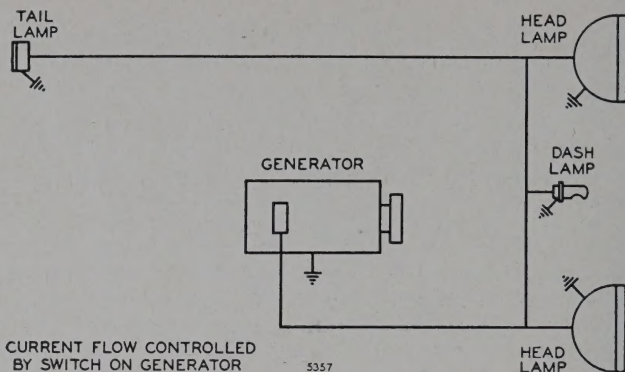
The voltage regulator is properly adjusted at the factory and should not be changed except in case of failure when both the regulator and generator should be taken to an automotive electrical service station that is an authorized dealer of the generator manufacturer, where the output of the generator can be checked and the regulator adjusted accordingly.

If the ammeter does not show a high charging rate, it is not an indication that the equipment is at fault unless the battery shows a low reading when checked with the hydrometer. The regulator permits a heavy flow of current from the generator to the battery only when the battery is low. As the battery becomes charged, the ammeter reading decreases proportionately until at full charge, no ammeter reading is evident.

If the hydrometer reading is low and no charge is evident on the ammeter, check the entire system for loose connections or broken wires. If all connections are satisfactory, check the generator for worn, broken or poorly seating brushes; also check the commutator to determine whether it is glazed or darkened. Refer to the topic, GENERATOR AND STARTING MOTOR.

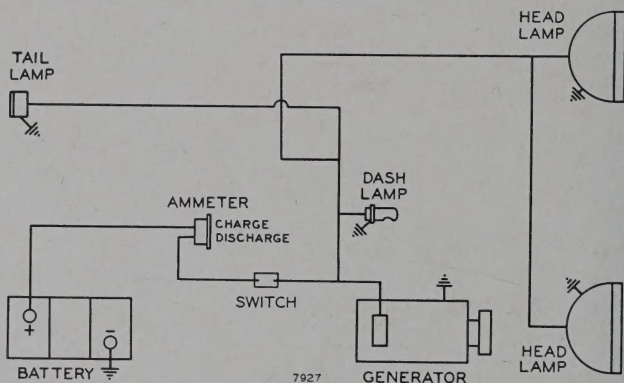
WIRING DIAGRAMS

These diagrams, covering wiring arrangements for use with and without battery and cab, are furnished so that when it becomes necessary to disturb the electrical equipment for purpose of repair or replacement, reassembling may be accomplished without difficulty.



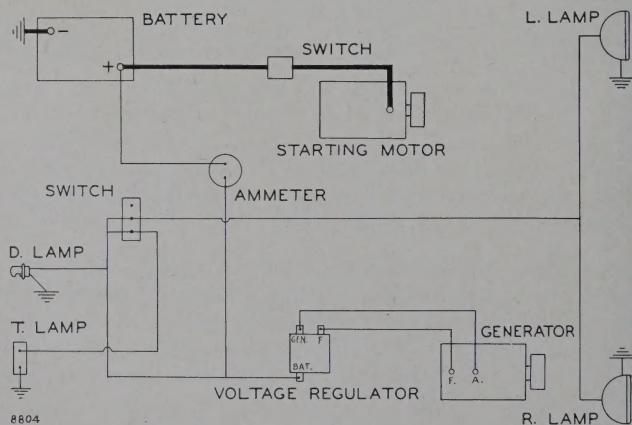
75 WATT GENERATOR—WITH CAB; WITHOUT BATTERY

With 130 Watt Generator add two rear lamps to above diagram. For 75 Watt Generator—for use without battery or cab, use above diagram and move one head lamp to tail lamp location. No tail lamp used in this group.



90 WATT GENERATOR—FOR USE WITH BATTERY AND CAB

For 90 Watt Generator—with battery; without cab. Use above diagram and move one head lamp to tail lamp location. No tail lamp is used in this group.



90 WATT GENERATOR—WITH BATTERY, 6 VOLT STARTING MOTOR AND CAB

#090.435
Surplus

CATERPILLAR TRACTOR CO.

PEORIA, ILLINOIS, U.S.A.

Track-Type Tractors . . . Road Machinery
. Diesel Engines

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